The International Journal of
Orthodontia and Oral Surgery

VOL. V ST. LOUIS, MAY, 1919 NO. 5

ORIGINAL ARTICLES

BIOMETRICS*

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WHEN Dr. Hellman requested me to address your Society on the subject of biometrics, I was at first disposed to decline the invitation. Biometrics is the application of mathematics to biological phenomena, and while I have done some statistical work, I am neither a mathematician nor a biologist. I decided to accede to Dr. Hellman's request because there exist misconceptions of the gravest sort concerning the utility of biometrics even among some of the most distinguished biologists. The aversion from exact statistical treatment of their data has communicated itself to not a few of the younger biologists, who dogmatically reëcho their masters' prejudices. In attempting to combat these dogmas, first by a brief examination of the logic of the case, secondly by a few concrete illustrations of how mathematical treatment has actually illuminated biological questions, I thought I should be rendering something of a public service.

THE FUNCTION CONCEPT

Up to the present day the determination of causes—*rerum cognoscere causas*—has been commonly assumed as the ultimate aim of scientific investigation. But in recent times advanced thinkers among the philosophers of science have found the concept of causality lacking in definiteness and are supplanting it with the mathematical concept of function. From their point of view, the entire universe appears as an assemblage of elements more or less closely dependent on one another, and the object of science is to ascertain the *functional* relationships of these elements.†

*Lecture delivered at the Annual Meeting of the Eastern Association of Graduates of the Angle School of Orthodontia, May, 1912, New York, N. Y.

†Foremost among those holding this point of view stands Professor Ernst Mach (Vienna). Cf. his *Die Analyse der Empfindungen*, ed. 5, Jena, 1906, pp. 73-77.

What, precisely, are you to understand by the term "function?" *The quantity "y" is a function of the quantity "x," if "x" and "y" are so related that to every value which "x" may assume there correspond one or more values of "y."* Thus, the cost of a package of tea is a function of its weight because the greater the weight the greater (other things being equal) is the cost. The time required to perform a journey is a function of the distance, because (other things being equal) it varies with the distance. The algebraical expression y^2 is a function of y, for whatever values we assign to y we obtain a corresponding series of values for y.[2]

The so-called natural laws of physics are expressions of such functional relationships. Let us take one of the simplest of physical laws for an illustration. Boyle discovered that, when other conditions remained constant, the pressure and the volume of a gas are inversely proportional: the less the pressure, the greater the volume, and *vice versa*. In other words the product of the pressure and the volume is a constant quantity. Pressure is a function of volume, and volume of pressure.

Now it is of the utmost importance for you to understand how the formulation of such a rule as Boyle's Law originated. I have not at my disposal, at this moment, the record of Boyle's observations. In their place I wish to substitute a table of observations on soap bubbles leading to a similar law. The pressure of the air confined within the bubbles and the diameter of the bubbles are as follows:*

d Diameter of bubble	p Pressure of Confined Air	dp
7.55	3.00	22.65
10.37	2.17	22.50
10.55	2.13	22.47
23.35	0.98	22.88
27.58	0.83	22.89
46.60	0.48	22.37

You observe that as d increases, p decreases. The product dp is approximately the same, no matter what may be the value of d or p. For all practical purposes the slight variations are negligible. We may, accordingly, idealize our table, simplify it by abstracting from the variations, and express the somewhat cumbersome table in the form of a shorthand résumé, to use Professor Pearson's phrase, and write the equation: $dp = d_1$ $d_1 = constant$. The diameter is a function of the pressure, and the pressure of the diameter.

You will now be ready to grasp the fundamental proposition of biometrics, which is simply this: that the student of biology is able to apply mathematics to his problems in essentially the same way in which the physicist applies mathematics to physical phenomena,—that by abstracting from observed reality unessential conditions he is able to describe the resulting simplified group of phenomena by a mathematical expression of functional relations that represents with sufficient accuracy the phenomena observed. True, the conditions may be less readily simplified in biology than in physics: my point is that the *principle* involved in the application of mathematics is in both cases identical. Logically, there is not the slightest reason why the predictions of a physicist with regard

*Young and Linebarger: The Elements of the Differential and Integral Calculus, p. 5.

to the movement of falling bodies or those of an astronomer as to the rotation of the heavenly bodies should be less liable to error than the biological predictions of the actuary of a life insurance company. As a matter of fact, we know that the physicist's and astronomer's predictions are verified in the majority of instances. And probably you are aware that the life insurance companies are not exclusively charitable institutions, but that the calculations of the actuary, founded on a statistical study of the *biological* phenomenon of mortality results, as M. Poincaré has humorously pointed out, in the payment of dividends to shareholders. The skepticism of the biologist with regard to the application of mathematics can not consistently be limited to biometrics but must be extended to mathematical physics and celestial mechanics; and in each of these cases the pragmatic test seems to rule his skepticism out of court.

REGULARITIES IN BIOLOGICAL PHENOMENA

Mathematical treatment of biological, as of physical phenomena, however, presupposes the possibility of noting a certain *regularity* in the behavior of the facts studied. If every falling body differed very considerably in velocity from every other falling body, no law of gravitation could ever be formulated. In studying such a biological phenomenon as the stature of a definite group of human beings, it would be absolutely impossible to represent the facts by a shorthand formula, an expression of functional relationships, if people of the same kinship group and living under the same conditions belonged to quite different stature groups, if Liliputian parents, to put the case drastically, gave birth to a gigantic brood like the devourers of Mr. H. G. Wells' "Food of the Gods," and if their issue in turn fell within all conceivable orders of stature. As a matter of fact, it has been found that the distribution of statures in any one definite locality is markedly regular. Thus, Johannsen quotes from Quetelet the following figures giving the height of 1,000 American soldiers.*

Stature of American Soldiers

	Number of individuals
5 feet 0	2
5 feet 1	2
2	20
3	48
4	75
5	117
6	134
7	157
8	140
9	121
10	80
11	57
6 feet 0	26
6 feet 1	13
2	5
3	3
	1000

Such figures could be multiplied almost indefinitely. Wherever a relatively

**Elemente der exakten Erblichkeitslehre,* Jena, 1909, p. 8.

pure population has been measured for height, the distribution of statures has been found to resemble that given for American soldiers. There is a congestion of frequencies about a central point corresponding to the average stature. As we take statures lower or higher than this central point, the associated frequency gradually diminishes until finally, say at the height of 4 feet or 7 feet, we find not a single member of our series. There is thus a characteristic correlation between frequency of occurrence and height within a definite group of observed individuals.

THE THEORY OF PROBABILITY

The Functional Relationship in Biology.—The fundamental question for us is this: Can the correlation between the frequency and the value of a certain measurement be definitely formulated in terms of a functional relationship? It has been shown that such is indeed the case: just as in the physicist's formula we may substitute any value we please for t (the time) in the formula for falling bodies, viz., $l = \frac{1}{2}gt^2$, and calculate l (the distance traversed), so it is possible to assign an arbitrary value to the stature and calculate therefrom the correlated frequency of occurrence. Without going into details or attempting to give the mathematical processes, a few words on the theory of probabilities will be in place here to give you some notion of the methods applied.

By the probability of an event we understand the ratio between the chances favorable to the occurrence of the event to the total number of chances for and against it. For example, if I throw a coin in the air, either the head or the tail may turn up. There are two possibilities, and one chance favorable in each case; hence the probability of a head turning up is $\frac{1}{2}$, and this is also the probability for a tail. It has been shown experimentally that when a coin has been thrown up say 16,000 times, there will be actually about 8,000 heads and 8,000 tails. If we throw up a coin, it is obvious that it *must* turn up either head or tail. The event of *either* turning up is, strictly speaking, not probable, but certain, and this certainty we denote by 1. On the other hand, if an event is absolutely impossible we denote its probability by 0.

This terminology can be readily applied to the frequencies of our table of statures. The total number of individuals measured being 1,000,* we express the probability of any measurement by one-thousandths of its frequency. Thus, there are 157 men of the stature 5 feet, 7 inches; the probability of that stature is accordingly $^{157}/_{1000}$.

It can be shown that the entire distribution of a stature series, as well as of many other variable measurements, can be briefly formulated by reference to *two* easily calculated values: the Average and the Standard Deviation (σ). The latter is simply the square root of the sum of all the squares of the deviations from the average, and serves as the measure of group variability. We can use the value of σ as a measure of variability in this sense that, provided our series conforms to the type of distribution usually found in stature series, we can calculate the probability of any deviation whatsoever from the average. It has been shown that in such a case the probability is about $^{68}/_{100}$ that a deviation

*As a matter of fact, the table given represents a reduction of the actual frequency of measurements to a total of 1,000.

will not exceed the standard deviation. In other words, if the average height of a group of 1,000 men is 5 feet, 7 inches, and the standard deviation 3 inches, about 680 men may be expected to have a height falling between 5 feet, 4 inches, and 5 feet, 10 inches. Now, that a deviation will not exceed the value of *twice* the standard deviation is much more probable, the figure being $^{954}/_{1000}$; that is, to use our illustration, of 1,000 men only 46 will be either shorter than 5 feet 1, or taller than 6 feet 1 in. Within the limits of the Average plus 3σ and the Average minus 3σ there will be a still greater percentage,—of 10,000 men we should have 9973 not shorter than 4 feet, 10 inches or taller than 6 feet, 4 inches. Finally, when we take a deviation of 4σ, the probability of such a deviation becomes so slight that it can be practically disregarded. In the case cited, out of 100,000 men we should find only 6 taller than 6 feet 7 in. and shorter than 4 feet 7 in. Comparison with a table of probabilities (such as mathematicians have prepared) enables us at once to determine the probable frequency of an arbitrarily selected measurement.

At this point I should not like to omit mentioning that the type of distribution exemplified by our stature series is far from being the only one actually found to occur in biological phenomena. Where it does not obtain, however, the biometrician's duty is exactly the same in principle as when it does hold. He must try to find some other way to summarize the facts, and here again his task does not differ in principle from that of the mathematical physicist in a corresponding predicament. For the sake of simplicity, solely, I shall confine my examples to cases of the type indicated.

PRACTICAL APPLICATIONS

Let us now see how we can practically apply our theory of probabilities. The problem that frequently confronts us is this: Do observed differences between two series compared represent *real* differences or are they dependent on accident? You must remember that while any group we may measure is, at least theoretically, composed of an infinite number of members, we never actually measure more than a limited number of individuals. You can easily see that if I attempted to determine the average height of this audience by picking out and measuring a single individual, I might pick out one that was 6 feet 3 or 5 feet just as likely as one that approached the real mean height. If I selected two individuals, it would be much less likely that both should be extreme variants; the average of the two would probably incline somewhat more towards the general height. For a larger series of measurements, the *error* of the average as compared with that of an ideal, infinitely large series still exists, but can be measured by the ratio of the standard deviation to the square root of the number of cases, $\frac{\sigma}{\sqrt{n}}$. If 10,000 men from the towns of a country have been measured, with an average of 170 cm. and a standard deviation of 7 cm., the error of the average is $\frac{\sigma}{\sqrt{n}} = \frac{7}{\sqrt{10000}} = \frac{7}{100} = .07$ cm.

Suppose further that in the rural districts of the same country we also measure 10,000 individuals and get the average of 169 cm. with a standard deviation

of 10 cm. Obviously, the error of our average here is $^{10}/_{100} = .10$ cm. We now have sufficient data for a comparison of the height of the urban and the rural population, for we have a rule for determining the probability of a difference of 1 cm. Without such a rule we could say nothing as to a stature difference between country and town folk, for as both series are limited, we could not know from the averages alone whether they fell within or without each other's normal accidental range. The formula in question, that is, the formula for the error of difference is: $\sqrt{\epsilon_1^2 + \epsilon_2^2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$

In our example $\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} = \sqrt{\frac{49}{10000} + \frac{100}{10000}} = \sqrt{\frac{149}{10000}} = 0.12$ cm.

Hence the error of the difference is .12. As the probabilities of errors follow a similar law to that of the probabilities of deviations from the average, it would be exceedingly improbable that our averages should be too large or too small by more than 4 times 0.12 cm. But our *observed* difference is more than 8 times as large as the error of the difference. We should then be quite safe in declaring that there is a real, not an accidental, difference between the stature of city people and of rural people.*

The method I have just outlined has innumerable applications in all the sciences dealing with variable phenomena, and as you are primarily interested in such applications rather than in the underlying mathematical considerations I will give several other illustrations.

Some years ago Dr. Channing investigated the hard palates of normal and feeble-minded individuals with the end of determining whether they revealed any real differences. Later he collaborated on this work with Dr. Wissler as biometrical adviser. From their joint publication† I take the following illustrations:

COMPARISON OF THE DISTANCE BETWEEN FIRST MOLARS

	n	Av.	σ
Normal	126	34.75	3.35
Feeble-minded	125	33.77	3.61

The error of the first average is $\frac{3.35}{\sqrt{126}} = .30$

The error of the second average is $\frac{3.61}{\sqrt{125}} = .32$

The error of the difference will be $\sqrt{.30^2 + .32^2} = .44$. The observed difference of the averages is only .98cm.,—only about twice as great as the error. In order that we could safely regard the differences as *real,* the difference would have to be four times as great as the error. Hence, we can not consider the hard palate of normal individuals and of feeble-minded individuals to differ in this particular feature.

*Westergaard; loc. cit., p. 187.

†The Hard Palate in Normal and Feeble-minded Individuals, *Anthropological Papers of the American Museum of Natural History,* i, pp. 283-369.

COMPARISON OF THE WIDTH AT THE CANINES

	n	A	σ
Normal	112	23	2.24
Feeble-Minded	124	22.36	2.61

$$\epsilon_1 = \frac{2.24}{\sqrt{112}} = .21$$

$$\epsilon_2 = \frac{2.61}{\sqrt{124}} = .23$$

$$\sqrt{.21^2 + .23^2} = .31$$

The observed difference is .64,—again only little more than twice the error of the difference. Accordingly, here again the theory of a real difference between our two series stands unproved.

Let me add an illustration from a different field. Some years ago thousands of Toronto school children were measured as to their height and other anthropometric traits, and a considerable number of facts were simultaneously noted as possibly serving to explain conditions that had to do with differences in the traits measured. Among these facts was the occupation of the children's fathers, which of course gave an approximate clue to their social position. An obvious question was whether social position and the conditions that go with it have anything to do with, for example, the children's *stature.* In order to determine this point we must separate our material into groups. Let us, then, tentatively separate the children of business and professional men from those of workingmen. Let us take the averages and standard deviations of our two groups. Suppose the ten-year-old boys of the well-to-do classes average 130 cm., while those of the poorer classes average only 128 cm. So far you do not yet know whether this difference is a really significant difference. You must accordingly resort to the rule of errors. If the number of cases is 100, and the standard deviation 6 cm. for both groups, then you have the errors

$$\epsilon_1 = \epsilon_2 = \frac{6}{\sqrt{100}} = .6$$

$$\sqrt{\epsilon_1^2 + \epsilon_2^2} = \sqrt{.36 + .36} = \sqrt{.72} = 0.848$$

The error of the difference then is 0.848.

Now, the observed difference is 2 cm. Dividing this by the error of the difference you have a ratio of 2 : 0.848. This is less than a ratio of 3 : 1, while you could not safely assume a real difference unless the ratio were at least 4 : 1. Hence it is not certain from the data at hand, whether social differences affect the stature of ten-year-old Toronto boys. But now assume that instead of having obtained the averages and standard deviations from groups of 100, you had had groups of 10,000 to deal with. Then

$$\epsilon_1 = \epsilon_2 = \frac{6}{\sqrt{10000}} = \frac{6}{100} = .06$$

$$\sqrt{\epsilon_1^2 + \epsilon_2^2} = \sqrt{.0036 + .0036} = \sqrt{.0072} = 0.085$$

The ratio of your observed difference to the error of the difference now becomes as 2 : 0.085. That is to say, the observed difference is more than twenty times the error, and accordingly you would be quite safe in asserting a real difference between the two groups, a real difference due to social position and its correlates.

This example is especially well fitted to illustrate the processes involved in biometric investigation. We started with the assumption that social position might affect the stature of children. Why did we make this assumption? It could not be suggested by biometrics or statistics any more than arithmetic could suggest to Galileo that the velocity of a falling body varied with the time. Galileo made *his* assumption because observation taught him that a body falls more and more rapidly as it descends. We made *our* assumption because observation seems to indicate that, other things being equal, the children of fairly prosperous parents are better nourished and taller than those of needy parents. In both cases the assumption must be tested by experience. If our assumption is not supported, we must frame some other assumption and see whether that works any better until we finally disengage some factor that does affect stature or whatever trait we are studying. These assumptions will depend not on our biometric, but on our biological, knowledge. We shall not waste time in considering assumptions that are quite contrary to all our biological experience, but shall select factors that bear a probable relationship to stature in the light of our present knowledge. But after we have done this, the exact formulation of our problem and the testing of our assumption becomes a matter of biometrics.

CORRELATION

In attempting an exact investigation of variable phenomena, we frequently have to ascertain not only the functional relationship between a certain measurement and its frequency or probability, but also the functional relationships between two or more measurements of a different order. We all know that tall men have in general a longer finger-reach than short men and are, on the whole, heavier than short men. We also know that this dependence is not an absolute one, for sometimes a very short man far outweighs one of superior height and, though rather more rarely, has a longer reach. Can we obtain a measure of the extent of correlation?

It would not be profitable in consideration of our limited time, to exemplify the method of computation employed, for which I should like to refer you to the popular account in Prof. Pearson's "Grammar of Science" (2nd edition, p. 392 ff.). But a single example, taken from the same work, may give you a glimpse of the logical aspect of the questions involved.

According to a popular belief, tall men and women have a tendency to marry short members of the opposite sex, and *vice versa*: in other words, there is a negative correlation between the stature of husbands and of wives.

The conceivable possibilities are as follows: Either the stature of the mate plays no part at all in the choice of a partner: in this case the correlation would be zero. Or, the statures of the mates vary with each other and are absolutely dependent on each other, so that the stature of a husband would be fully determined as soon as we knew that of his mate. This would be positive correlation in the highest possible degree, which may be indicated by the "coefficient of correlation" + 1. Or, we might have the condition favored by the popular belief if put in an extreme way. That is to say, the stature of either mate would again be fully determined by that of the other mate, but measurements would vary inversely with each other. This would be complete negative correlation and might be symbolized by −1. Finally, we may cite the only possibility that is actually realized, namely, that the stature of husbands determines that of wives to some extent, but does not *fully* determine it. That is to say, there is *some* correlation, whether negative or positive, but the choice of partners is affected by influences other than stature.

In order to test our popular theory, let us take 1,000 married couples, classing either the wives or the husbands in stature-groups. Now let us ascertain what is the average of the husbands or wives correlated with each of the stature-groups. It is clear that if there were *no* correlation whatever, the "arrays" of husbands or wives with each group of wives or husbands would be the same. No matter whether we took wives of 4 feet 6 or of 6 feet 1, we should invariably get men of the general average height associated with them. If, on the other hand, the inverse relationship supposed by popular belief existed, we should have female six-footers associated with men averaging say 5 feet, while men 6 feet 4 would form the array for women of 4 feet 6. What we actually do find is this: "—if the height of the husband is above the average, then the average height of the array of wives sensibly exceeds the mean height of wives; and if the height of the husband is below the average, the average height of the array of wives is sensibly below the average height of wives. In other words, tall tends to marry tall and short to marry short."* The popular notion of a negative correlation is thus nothing but a popular fallacy. There is a real positive correlation between husbands and wives, a correlation expressed by the coefficient .2872, which indicates a closer similarity between husband and wife than between uncle and niece so far as this trait is concerned.

I am painfully conscious of the fact that my remarks have simply grazed a subject of tremendous scope and importance, but I believe I have sufficiently explained my object in presenting the subject to your notice to render further apology unnecessary. For the, at least provisional, investigation of numerous problems, I hope I have shown you that very simple mathematical processes are sufficient. In your orthodontist work you are dealing, like the anthropologist and zoologist, with variable phenomena, and the application of these simpler modes of statistical treatment would undoubtedly aid you in the formulation and solution of not a few of your problems. Perhaps my foregoing remarks will serve to stimulate at least some among you to make this application.†

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*Pearson, Loc. cit., p. 431.

†In addition to the works already quoted, I should like to refer to a recent textbook on the subject, viz., G. Udny Yule's An Introduction to the Theory of Statistics, London, Chas. Griffin and Co., 1911.

FOOD DEFICIENCIES AS A FACTOR INFLUENCING THE CALCIFICATION AND FIXATION OF THE TEETH*

By Major F. M. Wells, F.R.S.M., C.A.D.C.

I MUST, in the first place, apologize to the Odontological Section of this Society and to the distinguished visitors who have honored us with their presence this evening, for having taken upon myself the task of introducing this subject. I can claim no special knowledge of these food deficiency products or so-called "vitamines." In fact I have only a very superficial and inadequate acquaintance with the various and varying theories that have been held on this subject.

The problem of food deficiency factors, or so-called "vitamines," has of late years received an increasing consideration, and there has been brought together from most different sources an abundance of facts which seem calculated to enrich our conception of the dietetic value of foods.

The investigations have revealed that satisfactory growth of nutrition can not be maintained upon a diet containing protein, fat, carbohydrate, salts and water, but that in addition certain other essential constituents are necessary, of which as yet, very little is known. These are known as accessory food factors, or "vitamines," and are present in a very small amount in most natural foods, and their chemical nature is unknown, but healthy life is impossible in their absence.

The diseases that are known to be produced by these accessory factors are beri-beri and scurvy, others which are believed to be caused by accessory factors, but of which the proof is incomplete, are rickets, sprue, and pellagra.

Before proceeding with the experimental part of the work done by Dr. Zilva and myself, I would like to give a short review of the work on scurvy and rickets, and a few of the many theories that have been advanced as to the cause of the rapid increase of tooth decay.

The etiology of beri-beri is well understood today, but as this disease is not endemic in this country and rarely occurs in infants, and so far as I know, it causes no dental disease, it is therefore not to our interest to discuss it here tonight.

Thrush or "sprue" is interesting to dentists, but as yet I know of no scientific work done on this disease.

Scurvy is not a new disease, as some people are led to believe. A description of scurvy is to be found in the narrative of the campaign of the Christian Army in Egypt under Louis IX, about the year 1260. The historian of that crusade was not only eye witness of the disease in others, but was himself attacked by it. He speaks of the debility and tendency to swoon, black spots on the legs, bleeding from the nose, and the livid and spongy condition of the gums, etc. The barbers used to go round trimming the gums of the sufferers.

Scurvy has unquestionably existed in the north of Europe from the most remote antiquity. That we have no mention of it in the early history of the

*Read before the Royal Society of Medicine, London, Eng. Published with permission of Col. Clayton, Director of Dental Services for Canada.

Northern nations must be imputed to the ignorance of the people, especially as regards medicine.

Well-marked, so-called florid, scurvy among infants was not an uncommon occurrence about the period 1875-1900, when artificial feeding was popular and patent foods were enthusiastically adopted. At the present day it is probable that mild incipient scurvy is more common than is usually believed. This condition is solely due to the rapid increase of artificial feeding of infants.

Obscured though the exact etiology of infantile scurvy may be, it is probable from clinical facts that this affection arises from causes distinct from those that produce rickets.

Almost all that is known of the pathology of scurvy among infants is due to the investigations of Sir Thomas Barlow and Professor Still, of the Great Ormond Street Children's Hospital, London.

In adult scurvy we have conclusive proof that the prolonged deprivation of fresh vegetables or their equivalent, is certain to bring about a scorbutic condition. We are also sufficiently familiar with the fact that proprietary infant foods do not contain the accessory factors that are necessary to prevent scurvy. It has been demonstrated experimentally that these accessory factors which prevent scurvy are contained in human milk and in the milk of the cow, but not in large quantities, but they are destroyed by the process of heating to a degree depending on the time and temperature of heating. It is clear then, and fair to say, that the further we go from a natural food which is consumed in the raw condition, like the mother's milk, the more frequent will be the risk of the disease. Dried milk contains less of the antiscorbutic factor than raw milk.

The age at which we should be on the *qui vive* for the initial symptoms of scurvy is about the eighth month of infantile life. It is exceptional when the symptoms appear earlier. This point is of considerable importance in diagnosis.

Professor Still in his clinical picture of the fully developed disease is striking enough; an infant who has been fed upon one of the patent foods, with or without milk, or on milk which has been condensed, sterilized, or otherwise altered, has been ailing for some weeks, has taken food badly and probably lost weight. Moreover, the mother says it cries whenever it is touched, and, as she puts it, "has lost the use of its limbs." The infant is pale, it lies quiet perhaps until it is approached, when it cries out in obvious dread of being touched; the legs lie motionless, usually with the thighs slightly abducted and averted, and the knee slightly flexed; the arms are less often affected. There may be some swelling of part of one or other of the limbs, obliterating the natural curves. Any handling of the affected limbs causes a piteous cry, evidently of acute pain. If teeth are present, the gums around them are swollen and purple, occasionally projecting like a mass of granulations, almost completely hiding the teeth, and bleeding readily when touched.

The urine is perhaps smoky, if not red with blood. Such in outline is the characteristic picture of infantile scurvy.

Rickets is believed to be a disorder of nutrition, and as such, affects the whole system. The bone changes are only part of a general disease. The child may suffer severely and yet not show so slight a degree or rachitic change in the bones that the disease might almost pass unnoticed, if only the osseous system

was considered. The temperature is normal, even during the most active stage of the disease. A rise in temperature is almost always due to some complication. There is little to be said in favor of an infective origin. Rickets among children in the British Isles has grown to a very alarming state. From 50 per cent to 80 per cent in London clinics show signs of rickets to a more or less marked degree. It is found in the dominion to a less extent, but it is quite common.

SYMPTOMS

Delayed dentition is one of the most constant symptoms. It has been found in 32 out of 42 consecutive cases between nine months and three years old that this was present. Frequently no teeth have appeared at the end of the first year. Rarely their appearance is delayed beyond the period of eighteen months. If dentition has begun before the onset of rickets, it is often arrested for several months. There is a striking tendency to very early caries, even before the tooth is fully out, the enamel at the cutting edge is often completely destroyed. Among other symptoms is sweating of the head during sleep, large protuberant abdomen, reluctance or inability to stand, which makes the child late in learning to walk, the softness of the bones and ligaments, which makes the bones bend and the joints yield, with the resulting bandy-leg, knock-knee or other deformity, stooping curve of the spine, large size of the head and square shaped, with all the tendency to convulsive disorders and to catarrh of the respiratory and alimentary tract, adenoids, chest affections, indigestion, etc.

The most prominent symptoms, no doubt, are those that affect the bones, but in rickets there is a general disturbance of metabolism and its effects are not limited to any one tissue of the organism. Until a cure is made, the disease prevents satisfactory nutrition of the bones and teeth, stunts and deforms the bones of the face and jaws, etc., and the damaging results are carried by the patient through the whole of his life, even after a cure is effected.

This great affliction, which appears to become more common every day, if not altogether prevented, can easily be remedied, if the baby is started off on a proper diet, which is the mother's milk and which every baby needs. If the conditions are such that the baby is prevented from getting its proper diet and has to be artificially fed, too much care can not be exercised in watching its progress for the first eighteen months, especially in regard to the weight of the infant.

The early stages of scurvy and rickets are almost impossible to diagnose and a baby that has to be fed on an artificial diet should never be allowed the use of a teat or "dummy," as the diseased condition of the bones, caused by the absence of the food deficiency products, with constant suction of a "dummy," will rapidly caused badly developed jaws and nose, followed by adenoids, nasal obstruction, irregular articulation of the teeth, mouth breathing and the whole train of evils to which this condition gives rise.

It is important that a baby's weight be kept normal. Rickety babies usually appear to be fat. If the disease is to be checked before serious harm is done to the child, the early signs must be recognized as soon as possible.

The first symptoms point to *pain from teething.* (Painful teething in children is just as much a disease as any other baby ailment.)

The second symptom is *late dentition.* (Every baby should have at least two

teeth between the sixth and seventh month). If the child shows these signs, rickets should be suspected.

It is amazing that these evils are known to exist, and it has been pointed out that they are due solely to improper diet, and yet medical men will allow mothers, who are quite capable of suckling their infants, to feed them on artificial foods and so deprive the infant of its heritage. Perhaps the fault lies in not having direct scientific evidence to show that a faulty diet is the direct cause of improper fixation and calcification of the hard tissue.

Now we will take up some of the most important theories that have been advanced during the past fifty years, as to what is the cause of the rapid increase of tooth decay. Miller's *Chemico-Parasitic Theory,* which accounts for the phenomena of caries of the teeth, does not explain the rapid progress made in the increase of dental caries accompanying civilization in the past hundred years. In view of the fact that the incidence of dental caries has been greatly on the increase, especially in the last fifty years, it would seem obvious that our present mode of treatment of dental caries was radically wrong, that the judgment of time and experience alike condemned it, and that such measures as are now in vogue have proved futile to arrest the progress of what has become the most prevalent disease of civilized communities.

HEREDITY

Professor Darwin, in his address to the British Association in 1909, set forth some of the difficulties which exist in accepting either the theory of pangenesis or that of the continuity of the germ plasma as an explanation of heredity. I have no intention, for I have not the necessary knowledge, to express an opinion on heredity. The only information that is at our disposal in regard to this theory, are statistics of family history, which appear to throw very little light on the subject.

Chemical analysis of our teeth has yielded us, so far, little or no information, and biochemistry is, as yet, still in its infancy.

To what extent do "vitamines" affect the enamel? We do not, at present, know how far differences in their action may modify the rest of the tooth, but the connection which appears to exist between the enamel and the odontoblastic cells is direct, if this is not so I should call it an "inborn error of metabolism." I know that I am going to be severely criticized by my friend Dr. Mummery, and very generally by all of the leading dental anatomists, who state, as I understand it, that when the enamel is once formed it is formed for good, but strong reasons have adduced me that this belief is not based on such sure grounds as is generally supposed.

I made a trip to Scotland last month with a view to studying the diet conditions in the Highlands and Lowlands. I have always been led to believe that the Highland Scotch had better bones than are to be found in any part of the British Isles, and I thoroughly believe they have. This is largely accounted for by their simple diet of natural foods. Up to a few years ago the Highlanders' meals were very simple. Their breakfast consisted of brose at 6 A.M. Brose is made by pouring boiling water over oatmeal, stirring all the time and adding a little salt. It was eaten with milk, syrup or treacle, and some had butter with it. The

next meal was between 11 and 12 o'clock, which consisted of potatoes and salt herring. No bread was eaten, but for the second course a bowl of milk and a piece of oatcake was taken. This was a universal dinner all through the North. The next meal was about 6 P.M.; again brose, but as a variation it was made with boiling milk instead of boiling water. Between the mid-day meal and supper they had a glass of milk, and in later years tea came in. The only variation from this diet was on Sundays. Breakfast was usually later and dinner, which consisted of boiled cabbage and turnips, was served after church. For supper on Sunday they had boiled potatoes and fresh fish and sometimes pork, but the pork was very sparingly used, as one pig had to last a family for the whole of the winter. Beef was rarely eaten.

Rickets is not known by Dr. Bremner, of the Department of Public Health for the County of Sutherland. He told me there has not been a case in his district. He also stated that the percentage of artificial feeding of infants was practically nil. A mother looked upon it as a disgrace if she was unable to feed her child, and it is only recently there has been a small percentage in the coast towns where the women are compelled to hawk their fish and render other duties which make it impossible for them to breast-feed their children, but away from the coast there is practically no artificial feeding.

A remarkable thing among the old type of fishermen today is that there is hardly any decay in the teeth of men of seventy to eighty years of age, but the young generation has quite a considerable number of decayed teeth.

The following is a little incident which I would like to relate. I happened to call on a very intelligent old lady, eighty-one years of age, and after a short conversation with her relating to the subject of my trip, she immediately told me that the curse of the Highland Scotch today was tea. All the crofters, or poor farmers, keep the teapot going from morning until night and are sipping tea all day long. I remarked that she had a very good set of teeth and she told me, in her broad Scotch, that she had lost one tooth through an accident and that she had never had a toothbrush in the house. I might state here that a toothbrush was hardly ever known among the last generation of the Highland Scotch. However, I will refer to the toothbrush and its uses later.

Dr. Bremner, of the Department of Public Health for Sutherland, gave me a lot of valuable information in regard to his examination of the men for the Army and Navy, from his district. He found that all of the men over twenty years of age and up to forty-five had exceptionally good teeth, as they advanced in years their teeth showed wear but no decay, but there was a vast difference in the teeth of the men under 20 years of age. I asked him what he thought it was due to and he said he thought it was due to nothing else except the rapid change in the diet. He also stated that there is an increase in tuberculosis, due to the same cause. The crofters, or poor farmers, are taking to artificial foods and discarding the natural foods. The oatmeal and potatoes are being exchanged with the grocers for white bread, jam, syrup and tea. These are all less valuable foods as regards content of accessory factors. I was told by one public health officer in the Highlands of Scotland that there are a great many families at the present time that make two meals a day off bread and jam or treacle and their mid-day meal consists of potatoes and fish and this class have become inveterate tea drinkers.

What a different condition presents itself in the Lowlands. I found in the Clyde district a different type of Scotchman altogether. The great reason for this is, to my mind, the diet of more refined foods. The people are better housed and sanitary conditions are better than in the North. Rickets and scurvy in the infant are as bad in this district as in any part of the British Isles and they have left their mark on the older generation. Nearly every person is wearing false teeth or presents a row of decayed teeth when he opens his mouth.

THE USE OF THE TOOTH BRUSH AND ANTISEPTICS IN THE MOUTH

Has oral prophylaxis been a success as a preventive against tooth decay? Our great army of dentists and teachers all over the civilized world are recommending the diligent use of the toothbrush. One dentist that I know conceived the idea that he could prevent his patients' teeth from decaying altogether by oral prophylactic measures. His method was to have his patients come to his office as often as he thought desirable, once a week or once in two weeks, etc., and thoroughly cleanse all the interproximal spaces. This kind of practice did not last long, as the cavities were multiplying so rapidly that he had to either send his patients to another dentist or return to his general practice. He decided on taking no chance of losing his patients, so he went back to general practice.

No, I do not believe the toothbrush ever prevents tooth decay. If the enamel will not resist the action of the fluids of the mouth, the toothbrush will not prevent the onset of decay on the surface of the teeth or in the interproximal spaces. It has been found that mouths that are immune to decay have very often a greater number of fermentative bacteria than the mouths of patients where decay is rampant. The plain fact is, that the toothbrush is a dangerous germ-ridden instrument, which it is impossible to sterilize. It can not be boiled and we have no disinfectant which would render it aseptic and not leave it unfit for further use. On my way back from Jena to Canada, in 1904, I called on my old friend, Mr. Gilmour, in Liverpool, and was telling him about some experiments that I had made during the summer with different tooth pastes and washes that are in general use. I showed him my results and told him how short a period the antiseptic properties of these washes would last and the increased growth of bacteria over the normal within a few hours' time, due to the destructive effect on the delicate mucous membrane of the mouth, causing an impaired condition of the natural resistance and thereby intensifying the growth of bacteria. In no case did the antiseptic action last over fifteen minutes. He then told me that he had been watching the results of different patients of his, that he could rely on as being very careful to cleanse the mouth out regularly, and that frequently they had an increased amount of work to be done over the previous year. On turning up his records I found some of his patients he was referring to were using the same pastes and washes with which I had experimented.

For our own comfort we have to keep the toothbrush going, but it is not going to prevent tooth decay. Tartar has never decayed teeth, but in lots of cases it has, I believe, saved them from decay. If you gather records of conditions of the teeth extending over a large area, you will find the least decay always where the toothbrush is not in use and this has been my experience all over.

We have, therefore, to look to some other source to find the true cause of tooth decay, and I think it can usually be traced to the improper diet of the child in infancy.

Antiseptic Washes.—The conception which prevails generally among medical and dental practitioners in regard to the use of antiseptic washes in the throat and mouth, is singularly confusing and confused. It is credited by them with consistent and often contradictory attributes, so great is the lack of clearness and precision of scientific work on this subject, when it approaches this topic, which has so weighty a bearing on our daily work. I began to despair of ever being able to get an antiseptic wash that we would be able to use on such a delicate structure as the mucous membrane of the mouth and throat, but through the work on flavine of Dr. Browning of the Bland-Sutton Institute we have now a wash that will not only act as a good antiseptic, without causing irritation, but its retentive powers are such that it keeps the bacterial flora down for hours, instead of a few minutes.

EXPERIMENTAL

This report is based upon histologic work carried out on the teeth and jaws obtained from considerably over 100 animals.

Method of Investigation.—For the purpose of this inquiry the lower incisor and molar teeth of the guinea pig were chosen. As in all rodents, these teeth grow from persistent pulp and are never shed. The teeth, while still *in situ* in the lower jaw, were decalcified and sections made in an anteroposterior direction, parallel to the long axis. In advanced cases of scurvy the teeth were apparently sound, but useless, inasmuch as they had been loosened by the gradual absorption of the cement membrane of the alveolar sockets, which had left exposed that portion below the neck. As a result there must have occurred that peculiar periostitic pain or something analogous which follows in the case of human patients who are suffering from shrunken alveoli. These teeth also presented, in addition, all the appearance of the changes of senility. A great number of longitudinal and transverse sections suitable for microscopic examination were obtained. The revelations offered by these sections are of a particularly interesting nature. Note the fine line of the dentine and odontoblastic cells as compared with Figs. 3 and 4.

Figs. 1 and 2 are of a normal tooth and give one the opportunity of studying the histology and pathohistology of the dental pulp in its normal relationship to dentine. The enamel is not quite as heavy as in the natural tooth on account of the decalcifying process which has reduced it to about half its thickness, but it gives one an excellent example of the typical appearance of the relationship to the dentine of the blood vessels, the fine cellular tissue and odontoblastic cells when in a normal condition.

Figs. 3 and 4. It is obvious that the term "Fibrosis" or fibroid degeneration, is the only one which can with certainty be applied to this particular form under notice. There is no doubt that it is a specimen of degeneration and it is equally easy to eliminate those other degenerative varieties, such as mucous, calcareous or fatty, which animal tissues may undergo.

The present instance affords an opportunity of examining certain structural metamorphoses in the pulp which are believed not to be dependent on any inflammatory condition, but simply attendant on and produced by altered metabolism of constitutional changes due to the diets.

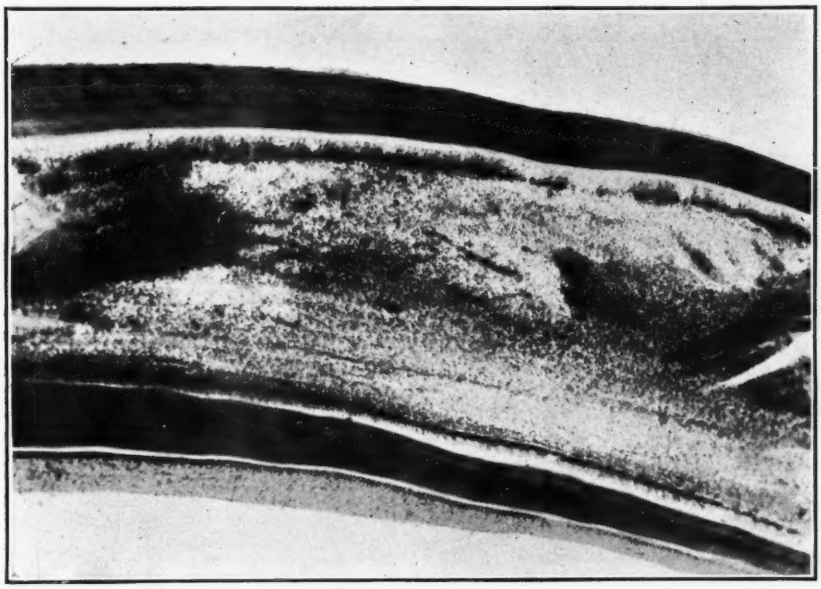


Fig. 1.—Normal guinea pig tooth 40 X.

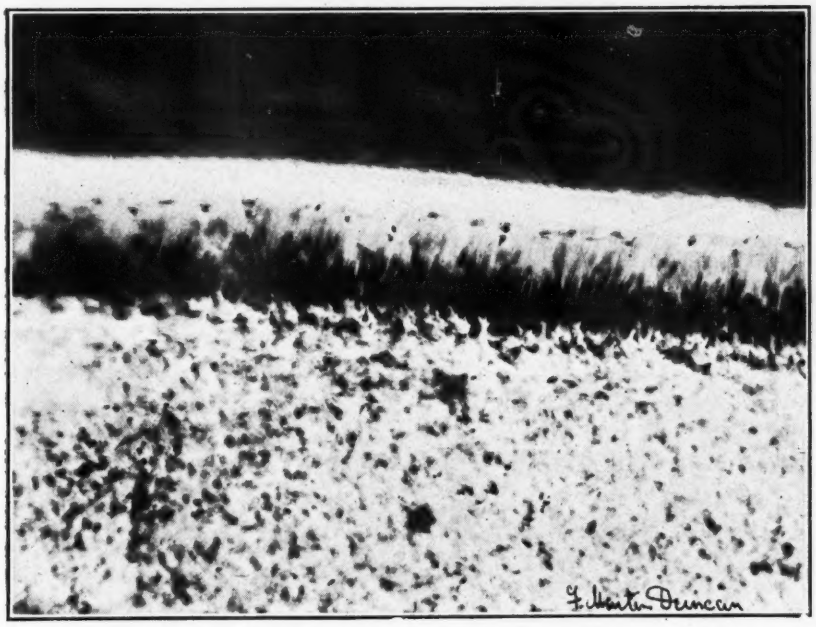


Fig. 2.—Same as Fig. 1 but 200 X.

Minute descriptions have been published on pulp nodules, calcareous pulps and elaborate work on ulcers and tumors connected therewith, but this affection seems to have been unknown or overlooked by the pathologists both in Europe and America. In no case does one find the condition as depicted in Fig. 2

brought about by a dietetic experiment. It is evident in this picture that in complete pulpar fibrosis no cellular elements of any description occurred. It is clear at once, and it is an important fact, that no trace of cellular organization, no trace of cell nucleus, no trace of interstitial cement substances can be found anywhere. Nerves, cells, blood vessels and odontoblasts have all shared the proc-

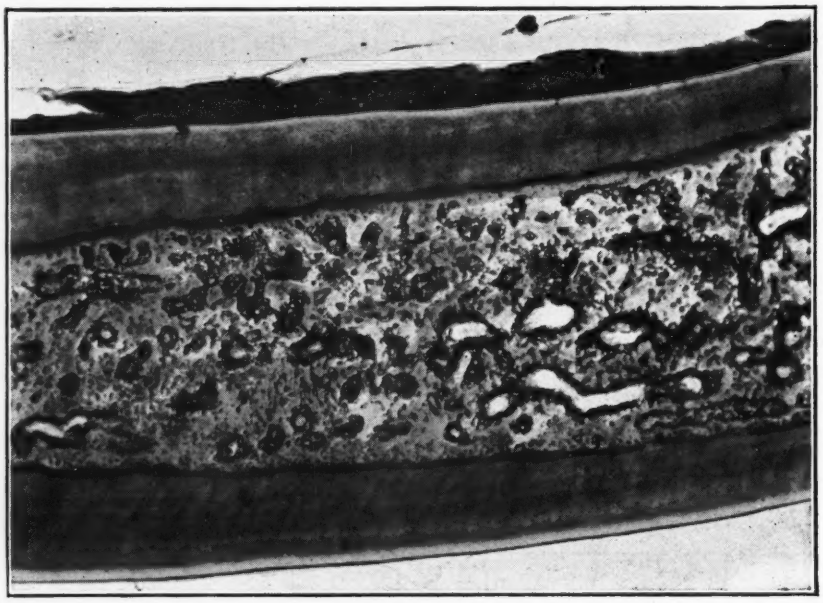


Fig. 3.—Scorbutic condition of guinea pig tooth as shown 15 days on scorbutic diet 40 X.

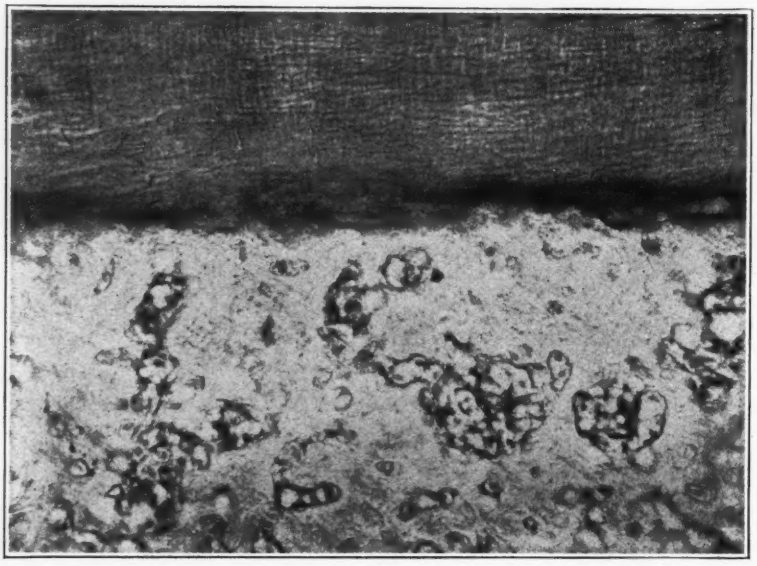


Fig. 4.—Same as Fig. 3 but 200 X.

ess of fibri-fication and are no longer recognizable. The fine cellular connective tissue, which is but a loose mass of network in the normal state, has either become grossly hypertrophied or quite obliterated and its place taken by a new, firm, fibrous structure, devoid of cells, nuclei, or any regular arrangement of constituted parts.

Figs. 3 and 4 show an advanced state of scurvy. The irregular osteroid condition of the dentine is well marked and the different refractive appearance of the dentine is probably due to the hemorrhagic condition of the dentinal fibrils.

In a scurvy tooth the condition persists right up to the apex of the root; the trouble at first appears to start in the odontoblastic cells at the top of the pulp, working toward the apex, followed by distended blood vessels and hemorrhage, then complete fibroid degeneration follows.

With the object of obtaining some insight into the condition of the teeth of pregnant guinea pigs, I placed eight pigs which were in a more or less advanced state of pregnancy, on a scorbutic diet, to study the biological relation existing between the mother and offspring. Two of the guinea pigs that were used for this experiment were in the early stages of pregnancy, the remaining six being at an advanced state. The diet given, in each case, consisted of autoclaved milk, oats and bran. The pigs which were in the early stages of pregnancy died on the 11th and 13th days respectively, and death from intestinal infection was suspected.

Microscopic sections were made of the teeth of the mother and offspring of the hemorrhagic condition and the very early stage of pregnancy, nothing could be discovered.

The six pigs that were in an advanced state of pregnancy all dropped their young at various stages of the experiments, from 11 to 15 days.

Microscopic sections were made of the teeth of the mother and offspring and in every case an advanced state of scurvy could be seen. No. 5 will indicate the condition of mother and No. 6 the condition of offspring, which are typical of results obtained throughout the experimental work which was afterwards carried on by Dr. Zilva and myself. It is not necessary to discuss the remaining cases of this group, as they all exhibited similar symptoms.

This work has to be carried out more extensively, as it is a little premature to make a positive statement, but the indications lead me to believe that the pigs during pregnancy, are more susceptible to scurvy than when in a normal condition.

For the past four months I have been working on rickets, but my great difficulty has been to obtain material for histologic work.

Advanced cases of rickets are not so common now as they were from 1890 to 1895, when artificial feeding of infants was at its height, and when less was known of the contents of artificial foods.

Today if a child enters a hospital and rickets is diagnosed, a cure is brought about in a very short time, consequently material to be had from infants for histologic work is very rare indeed.

Mr. Sidney Spokes kindly gave me some old specimens and from these I made a great many sections, which lead me to believe there is a great change taking place in the enamel organ. These sections are not sufficiently clear for me to exhibit, as the material is very old and the sections I made are very poor, but the results are sufficient to show that the enamel cells are greatly deranged from the jaw of a child eight to nine months old. Mr. Spokes has kindly lent me his sections which he made from the same specimen when he first obtained it a few years ago and which is exhibit No. 9.

This work is to be further developed and I expect within a very short time to have a considerable amount of material with which to work.

The teeth were all decalcified in a solution containing 40 per cent formaldehyde, 30 per cent formic acid and 20 per cent distilled water. This is rather a slow process, but I found it gave better results than the more rapid method. The rapid method which I used was to decalcify with phloroglucin and nitric acid. This process will give very quick results but is not so efficient as the slower method. After the decalcification was complete, sections were cut by freezing in gum and then staining with Ehrlich's acid hemotoxylin and eosin.

Throughout the whole of the experimental work the earliest alteration to be noticed first takes place in the odontoblastic cells, in the upper part of the pulp, working gradually down to the apex, followed by dilatation of the blood vessels and hemorrhage.

CONCLUSIONS

That scurvy does affect the pulp is indisputable and is not a theory but an absolute fact, a doctrine in a true sense.

Records that have been made of patient's mouths during the eruption of the second dentition, in regard to the decay of the teeth, must be very unreliable. How many in this room could give a proper record of their diet even for three days if asked to do so? I venture to say there are very few who could state everything they had eaten for three days, or twelve meals, including tea.

The dentists who are working in infant and children's hospitals are the most fortunately placed to get reliable information for records that would be of great assistance in studying the development of the first dentition from a dietetic view. But this work, like all other medical research, has to be carried on in animal life, if scientific results are to be obtained, and work that is carried on with animals that are always kept in cages and carefully watched and given a certain diet, is bound to give a definite result, if the experiment is repeated often enough. We have used considerably over 100 animals in this experiment.

I am obliged to confess that twelve years ago when I published my first article on the effect of artificial light on infants in regard to the calcification of the teeth, I certainly thought that it played a much more important part than the diet. It was while I was arranging my work to carry on my research still further with the artificial light that I was attracted by the work that was being done in the Lister Institute on scurvy. After having examined the teeth of several animals that had been given a scorbutic diet, I found the pulp of the teeth was affected, even before any clinical symptom appeared in any other part of the system. This led Dr. Harden, Dr. Zilva, and myself to believe that it was more important to go on with the dietetic experimental work than the artificial light.

To Dr. P. P. Laidlaw of Guy's Hospital, I wish to express my gratitude for much useful advice and help in the histologic work, and to Mr. F. Martin Duncan for the pains and skill taken with the photomicrographs.

A CONSIDERATION OF FREQUENT CAUSES OF MALOCCLUSION

By William B. Power, D.D.S., Seattle, Wash.

IN a paper which I read before the King County Dental Society April 2, 1918, published in the August issue of the Journal of the same year, I took up in a general way some of the most frequent causes of malocclusion, as I observed them in my own practice. The publication of that paper caused some little discussion by men who read it, and to further substantiate some of the conditions which I have mentioned, I am writing this paper, illustrated with a number of malocclusions which I believe present positive etiologic factors that are so clear that they can not be misinterpreted for anything else.

Under the head of constitutional conditions, I stated "rickets" was a disease that was very liable to cause malocclusion and which produced typical conditions that could be very easily recognized in most cases. Rickets is a disease which may manifest itself at any time in the life of the individual, the malocclusion will present certain characteristics depending upon what time the child acquires the disease. One of the earliest symptoms of rickets is that the deciduous teeth are lost early and the permanent teeth erupt late. Given such a clinical history in any case, malocclusion is always sure to develop, and when the two conditions go together, complicated by the constitutional disturbance as found in rickets, malocclusion of the most severe type is very liable to occur. With

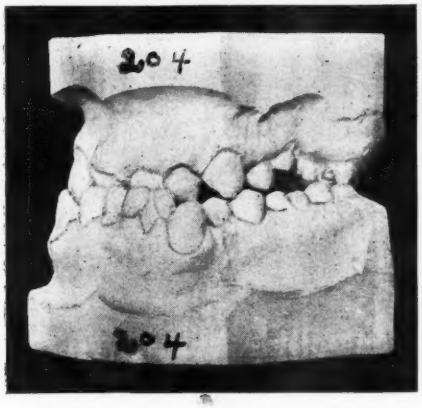
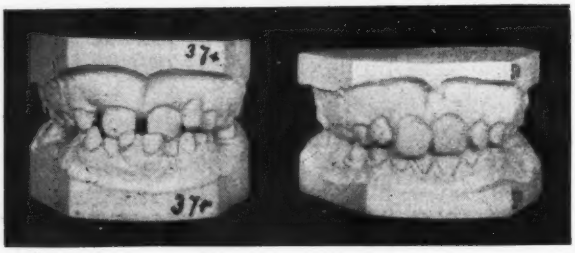


Fig. 1.—A condition resulting from rickets.

Fig. 2.—Shows superior arch of same case as in Fig. 1.

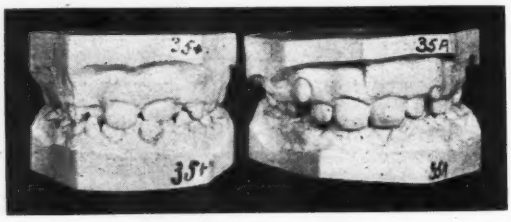
children that have the disease only to a limited extent, the malocclusion is characterized by a lack of development of the upper arch with more or less bunching of the upper anterior teeth and a tendency for the overdevelopment of the lower arch. Fig. 1 shows such a case. Fig. 2 shows the occlusal view of the upper dental arch in which will be noticed the large well-developed rugæ of the palate which also is associated with rickets. The alveolar process is thick and spongy and the alveolar ridge is thick and the teeth will move quite easily. The tardy eruption of the teeth from any cause will, of course, produce a maloc-

clusion, but in the majority of those cases where this tardy eruption occurs, rickets will probably be present. Fig. 3A shows the front view of the case in which there is a spacing between the central incisors that has been produced by the abnormal development of the frenum, but this spacing is further augmented by the fact that the upper lateral incisors are unerupted and are really late in erupting. Owing to the lack of approximal contact, the action of the lip and the abnormal frenum, the upper central incisors have drifted apart, and taken a lingual position. The whole case is one which will present a very complicated condition and one which will grow worse as the individual grows older. It is another case which demands immediate treatment and is one which by no means should be allowed to wait, neither should the parents be told the case can be treated a little later as easily as it can now. Fig. 3B shows the result that has been accomplished by treatment, and could be more easily obtained at that time than



A. *B.*

Fig. 3.—*A.* This shows superior centrals in lingual occlusion, with right lateral unerupted. *B.* A result in same case easily obtained.



A. *B.*

Fig. 4.—Anterior teeth in wrong position due to interlocking of inclined planes of teeth.

it could ever be obtained at any later period in the individual's life. I am showing this case not only as a possible factor of etiologic interest, but also one which emphasizes the importance of treating certain types of malocclusion immediately and to discourage the idea of telling patients to wait.

In the study of normal occlusion, we have been told that the force of the inclined plane was one of the factors which caused teeth to assume and maintain their proper position in the line of occlusion. Now the force of the inclined plane is active and normally produces normal occlusion but when for any reasons the force becomes abnormal it will cause the malocclusion to become more extreme as the individual advances in age. The model on the left of Fig. 4 shows a case in which the abnormal locking of the inclined plane of the central incisor, as well as the abnormal approximal compact in both the upper and lower teeth are producing a type of malocclusion which will grow worse the older the individual becomes. In other words, the incisors are so locked that malocclusion is the only thing that can possibly exist and is the only development which will

occur following the subsequent eruption of the other teeth. We might say the entire treatment of this case lies in getting the two forces of occlusion that are abnormal to act properly, namely, the force of the inclined plane and approximal compact. If these forces are corrected and continue to act as they should, the malocclusion, of course, will be necessarily corrected and normal development will progress from this point.

The loss of any deciduous teeth will produce malocclusion, and when given a certain deciduous tooth that is lost, we can absolutely portray the future malocclusion that will develop. The loss of a deciduous tooth produces malocclusion in at least two ways, first, by destroying and interfering with the mastication of the teeth which in turn disturbs the mechanical stimulation of the supporting structures. Secondly, the loss of the tooth interferes with approximal contact which in turn allows the dental arch to collapse and that in turn produces inharmony in the size of the arches, which has an influence on the opposing arch and eventually destroys the force of the inclined plane. In Fig. 5 we have the loss of the lower right canine and the lateral incisor has drifted lingually and

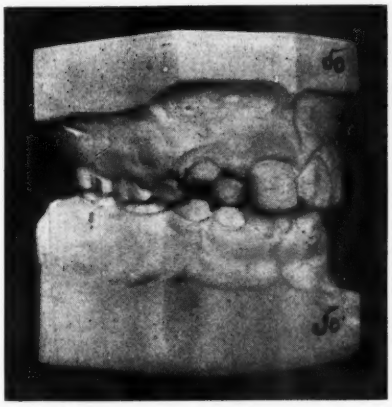


Fig. 5.—A condition resulting from the loss of the lower right deciduous cuspid.

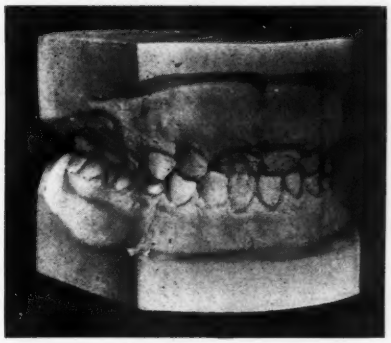


Fig. 6.—Superior central deflected into malposition.

to the right until it is in contact with the first deciduous molar. The result of this is the lower arch is smaller by the width of one tooth which has resulted in the bunching of the upper arch, and which will result in the impaction of the lower canine or the premolar, depending upon which of those teeth attempt to erupt last. The only treatment for this case is to restore the normal sizes of the upper and lower arch and make the proper space for the permanent teeth in the lower arch so they can come in and occupy the normal approximal contact. This is another case in which it was very unwise to delay the treatment because of the condition that will simply be postponed from one tooth to the other as each succeeding tooth erupts, even though the malocclusion does not become apparent in early life. We see a large number of these cases in which the parent failed to realize that one tooth was short in the lower arch and they come to us to have only the upper arch straightened because that is the only one which to them shows any malocclusion. We have even known dentists who are so unfamiliar with the dental anatomy as to overlook the missing tooth in the lower arch until their attention was called to it.

In order to more thoroughly show the force of the inclined plane as a factor in producing normal occlusion or malocclusion, I am showing Fig. 6 which was another simple case but the whole etiologic features lie in the fact that the upper central incisor has become deflected and from now on will continue to occupy a malposed position, unless the mechanical interference is instituted to correct it.

We have mentioned the fact that the early loss of the deciduous teeth is an etiologic factor in the production of malocclusion, but it must also be remembered that the prolonged retention of the deciduous tooth or even the retention of a small portion of a deciduous tooth will produce various types of malocclusion. In Fig. 7 we find the upper central incisors wedged between the centrals and laterals, and the deciduous root is still in position. The position of the upper central is without question the result of force of inclined plane, during the time it erupted against the retained deciduous root. As a prophylactic measure in the prevention of malocclusion it is very imperative that the child's mouth be examined at various intervals and the deciduous roots be extracted

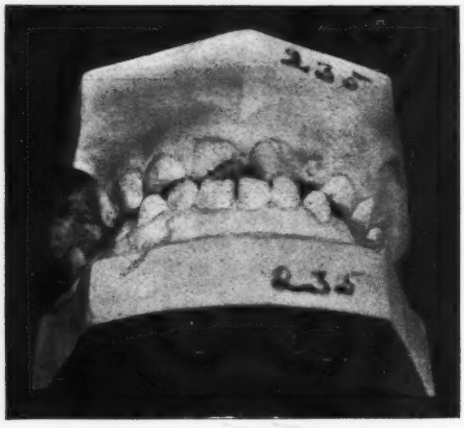


Fig. 7.—Superior central wedged crosswise between lower central and lateral. Deciduous roots still in place.

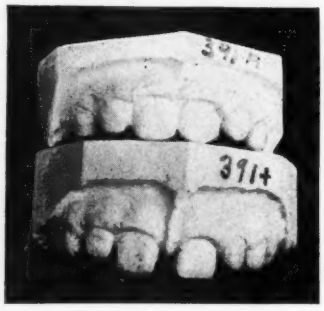


Fig. 8—The removal of the frenum labium and a small amount of treatment obtained a satisfactory result in this case.

so as to avoid such conditions as are shown in Fig. 7. As to the possible time when a deciduous root should be extracted so as not to produce a malposition of the permanent teeth, that can only be decided by frequent study of the conditions after the teeth have been radiographed.

In the majority of those cases where all the upper teeth are in normal approximal contact, and we find a large space between the central incisors, this spacing is generally the result of the abnormal development of the frenum-labium. The exact cause of the development of the frenum or abnormal size of the frenum is still a disputed point and in some type of the maldevelopment the most logic treatment beyond the question of a doubt, is the surgical removal of the frenum and then the drawing of the incisors together. Fig. 8 shows such a case before the removal of the frenum and also the same case after the frenum was removed and the central incisors brought into position. It must be remembered that every case of the separation of the upper central incisors is not an abnormal frenum case, and consequently the condition must be very carefully

observed, before making a prognosis as to the outcome of the case or also a diagnosis as to the etiologic factors involved.

Another common type of malocclusion or rather another common condition which will produce malocclusion is supernumerary teeth. Supernumerary teeth may make quite a spectacular malocclusion, but as a rule such malocclusions are comparatively easily treated by the removal of the supernumerary teeth and the bringing of the normal teeth into occlusion. I wish to say that missing teeth are also factors in the production of malocclusion, but of the two, supernumerary teeth are much more easily treated from the standpoint of permanency, because all the tooth material is present that is necessary to produce the normal

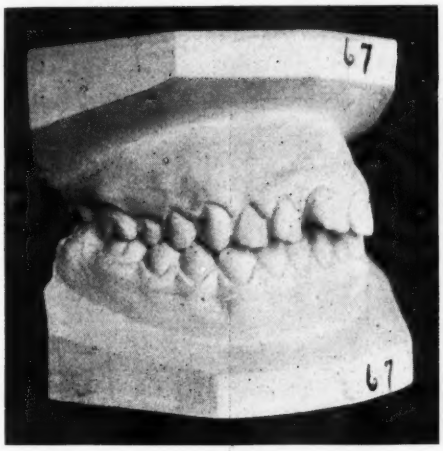


Fig. 9.—A very unsightly form of malocclusion caused by a supernumerary tooth.

Fig. 10.—The growth spaces are easily seen, with the lower centrals erupting in a lingual position. Teeth thus erupting are often mistaken for malocclusion.

Fig. 11-A.—A frenum labium case.

Fig. 11-B.—The abnormally large frenum labium was removed in this case. No appliance was used to move the teeth which were widely apart, yet this was the result at the end of two years.

occlusion. In cases produced by missing teeth the tooth material is lost and it consequently follows that in the correction of the malocclusion present the result is never entirely satisfactory, owing to the missing tooth material, which makes the attaining of normal occlusion or normal masticating efficiency impossible. Therefore, I would say that of the two evils, the case produced by the supernumerary tooth lends itself to more satisfactory treatment than the case produced by the missing tooth.

In considering the causes of the malocclusion, it is very necessary to take into consideration the age of the patient, for in some instances a malposition at

a certain age may be corrected by a normal growth, associated with normal forces of occlusion; provided all forces of occlusion are normal. In Fig. 10 is shown the upper arch of a child in which spaces are seen to be present between the deciduous incisors which indicate the upper arch is developing to accommodate the permanent teeth. However, for some reason or other in this particular individual, the growth was not rapid enough to accommodate the eruption of the lower permanent teeth, and we find the lower central incisors occupy a slight position of linguoversion. Some of these cases demand treatment, while others when present in children that are assuming an active period of growth, will be carried out to the proper position by the normal tongue action. If a child is a normal breather with normal lip and tongue action and the proper physical development at that time, the natural forces of occlusion and natural

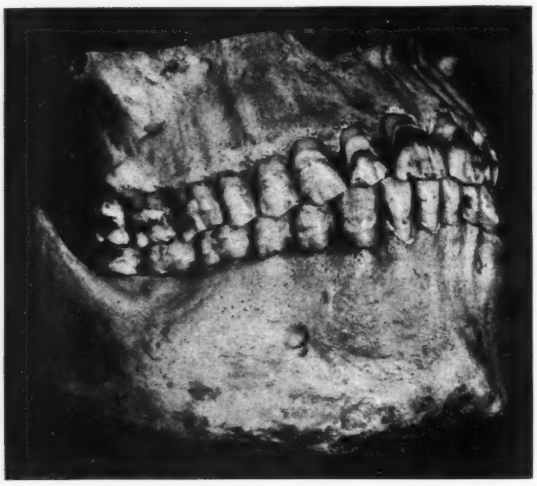


Fig. 12.—As the occlusion should be.

growth may overcome the slight deficiency shown in Fig. 10. However, with a slight malocclusion occurring we may just have the reverse, in which case the growth will stop at this point, Fig. 10, nothing will be carried any further, and the mechanical interference will have to be instigated to produce the development that nature has failed to get up to this time. The question of the treatment of such cases as shown in Fig. 10 is one which has to be very carefully considered and the child kept under close observation in order to see whether the normal development is going to take place, or whether mechanical interference must be started to supply what nature has failed to do up to this time.

Fig. 11 also shows a very interesting case but you will have to take my word for the condition, as this case was one in which an abnormally large frenum was removed. No appliance was used to move the teeth together, which were very wide apart, still the results as shown in this model occurred at the end of two years. I am showing this case to substantiate the fact that some man claimed that abnormal frenums are not etiologic factors and that the removal of them does no particular good. From clinical observation I am convinced that the spacing between the teeth as originally present was the result of the abnormal frenum and after the frenum was removed the etiologic factors

were gone, and nature was able to care for the rest by establishing normal forces of occlusion.

I might further say that any type of malocclusion which develops is the result of the forces of occlusion going wrong, and if all the forces of occlusion act normally there is a normal occlusion as shown in Fig. 12, which is the ideal for every type of malocclusion treated.

TEACHING ORTHODONTIA*

By W. E. Stoft, D.D.S., Omaha, Nebr.

THE teaching of orthodontia is a difficult proposition, especially in the dental college, where it is presented with the idea that the course is not expected to fit the student to practice this branch of dentistry with any degree of success and only gives him the theory which he may or may not retain after he passes the final written examination of the college and the state board, and which then, will have to be worked out in practice attended by the usual difficulties, incident to initial attempts at the correcting of malocclusion. That student-dentist is an exception, who succeeds in spite of these conditions and the percentage is indeed small. There being a number of teachers in the alumni association and probably some among the present graduation class, I offer these suggestions.

Since there is so much malocclusion to be corrected, I believe we should endeavor to give the students under us as much practical knowledge as we possibly can.

The following, I offer mainly because I believe many colleges are not giving orthodontia the attention that Creighton gives. The junior class gets the usual thirty-two weeks of lectures during the year, while the seniors are handled a little differently.

Each senior is required to handle one case all through the year, the clinic being ample for this. Besides treating this practical case he is required to write a paper on it and read it before the class, during the regular lecture period: the schedule for these papers being so arranged that the student has had time to get a working knowledge of his case and, too, that each will have time to prepare well. I usually have two papers each period and that allows us a little time for general discussion and "fill-in" explanations by the lecturer. This gives the entire class a good insight into all the orthodontia cases, widening their scope of experience, etc.

The system used to prepare the students to handle their cases and which helps them materially in writing their papers was suggested to me by Dr. Brady and consists of three diagrams illustrating, on the first, the malpositions of the teeth being drawn with black ink and over this the correct positions in red ink.

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*Read before the Alumni of the International School of Orthodontia, Kansas City, Mo., July 9, 1918.

On diagram No. 2, which is a carbon copy of the malposition as shown on Diagram 1, I draw the appliances to be used; on diagram No. 3, I draw over the carbon copy of the correct positions as shown on Diagram 1, the retaining appliances.

All this, of course, takes time and is only successful when studied and understood by the student, so insisting on a careful study by the student is important.

This eliminates that terrible condition of misunderstanding and misapplication by students who forget what you have told them about the case the minute your back is turned and, taken all together, is a time saver.

I have found in my five years' experience that the hardest thing to overcome is the student's estimate of the importance of orthodontia, so I hail with delight the fact that I now have two years of blood test figures before and after the treatments to show how the correction of malocclusion in one hundred per cent of cases raises the red cell count. In some cases there has been an increase of over one million red cells and this increase seems to correspond to the

ORTHODONTIA CASES—RED CELL COUNT—1916-17—1917-18

PATIENTS	SEX	AGE	BEGINNING	CORRECTED
1. Helen M.	F.	16	3,392,000—	4,560,000
2. Catherine M.	F.	13	3,632,000—	4,600,000
3. Gladys C.	F.	12	3,680,000—	4,896,000
4. Dorothy H.	F.	15	3,808,000—	4,784,000
5. Raymond G.	M.	12	3,888,000—	4,768,000
6. Beatrice C.	F.	14	3,904,000—	4,512,000
7. Elizabeth N.	F.	13	4,064,000—	4,848,000
8. Foster C.	M.	14	4,080,000—	5,040,000
9. Frank F.	M.	11	4,144,000—	5,120,000
10. Waldron G.	M.	15	4,400,000—	4,624,000
11. Gayle W.	F.	11	4,608,000—	5,024,000
12. Thos. D.	M.	15	4,512,000—	5,040,000
13. Esther C.	F.	13	4,720,000—	4,800,000
14. Helen S.	F.	13	4,736,000—	5,072,000
			57,568,000—	67,688,000
FOURTEEN PATIENTS' AVERAGE =			4,112,000—	4,834,857
15. Tom M.*	M.	12	4,080,000—	3,904,000
16. Roy A.†	M.	16	3,520,000—	
17. Tom C.†	M.	13	3,712,000—	
18. Josephine A.†	F.	14	3,824,000—	
19. Robert W.†	M.	8	4,000,000—	
20. Catherine M.‡	F.	14	4,800,000—	
			81,504,000—	
TWENTY PATIENTS' AVERAGE =			4,075,200—	

*Occlusion disturbed in the process of correcting—not so good as when started.
†These cases started but failed to finish.
‡Malocclusion only slight, no final count.

amount of occlusal surface contact increase. This has a wholesome effect upon the students and stimulates interest in orthodontia.

The jubilee is coming for orthodontia, so I hope no one will become discouraged because it is yet a little ways removed. I don't claim to have cleared up all the difficulties incident to teaching this subject, but I hope only to have offered a suggestion or two worthy of consideration and modified application.

SECOND YEAR'S TEST

ORTHODONTIA CASES—RED CELL COUNT—1917-1918

PATIENT	SEX	AGE	BEGINNING	CORRECTED
Lois S.	F.	13	3,296,000—	4,640,000
Helen H.	F.	14	3,920,000—	4,720,000
Everett H.	M.	11	4,000,000—	5,008,000
Helen E.	F.	12	4,080,000—	5,120,000
Dorothy R.	F.	11	4,128,000—	4,640,000
Minnie S.	F.	15	4,144,000—	4,880,000
Francis N.	M.	11	4,352,000—	5,168,000
Esther R.	F.	14	4,384,000—	5,008,000
Vera B.	F.	15	4,880,000—	5,040,000
Alma A.	F.	15	5,040,000—	5,360,000
Gertrude G.	F.	16	5,088,000—	5,184,000
Corine A.*	F.	12	4,222,000—	4,168,000
Barney R.*	M.	9	4,928,000—	4,768,000
			56,462,000—	63,704,000
		THIRTEEN PATIENTS' AVERAGE =	4,343,231—	4,900,307

*In these two cases the occlusal surface contact was decreased in the process of treatment.

HISTORY OF ORTHODONTIA

(*Continued from page* 128, *Vol. V*)

By Bernhard Wolf Weinberger, D.D.S., New York City

F. E. HOWARD before the Seventh and Eighth District Dental Society presented a paper entitled *Irregularities of the Teeth and Their Treatment.* (*Independent Practitioner,* 1886, page 359.)

"A modification of the Coffin system will be useful in many different ways; for instance, if the arch is to be expanded in the main, a spring bent in the general form of a *W* is arranged in position about midway of the plate, and when vulcanized the plate is sawed through the center, the spring slightly opened, and the plate placed in position. From time to time this is spread as the case requires.

"When the anterior portion of the arch is to be spread, a hinge made of two eyes and a bar, joined and vulcanized into the posterior portion of the plate will hold the posterior part, while the spring will act upon the anterior part alone, or this may be reversed and the back teeth spread at the will of the operator, as the case may require.

"Instead of a hinge a more simple method will sometimes answer as well. Drill two holes in the back of the plate, and with a strong silk ligature or platinum wire bind the parts together, and this will hold them from spreading at this point.

"A piano-wire spring, vulcanized into the plate, is also very effectual for moving a tooth out when it is inclined in the mouth and it is not desirable to use a jackscrew. For the movement of canines and bicuspids, a band of platinum with a projecting top or knob cemented to the tooth, is admirable to retain the rubber or silk ligature in position, and to draw the tooth in its proper course, the ligature being attached to some point on the plate, or to a hook attached to some tooth not likely to change position by the force exerted.

"For the rotary movement of a tooth, a band of platinum with an arm attached and cemented to the tooth is a powerful agent for twisting such a tooth into position. Also a good and simple method for this movement, as applied to the four anterior teeth, is accomplished by tying a waxed silk thread to any of them, taking two or three turns around the tooth and attaching to a rubber ligature fastened at some convenient point in the plate. The force exerted is in a direction to unwind the ligature from the tooth, and thus it is turned in its socket."

B. S. Byrnes under *Correcting Irregularities by the "Spring" of Gold Bands,* introduces several novel methods in orthodontic procedure as illustrated in the *Cosmos,* 1886, page 278.

"In correcting irregularities of the teeth I have employed in a large number of cases a new device of my own invention which seems to possess many decided advantages over the methods in common use. A brief oral description presented to the last meeting of the Southern Dental Association, held at New Orleans, was so favorably received that it has seemed desirable to communicate the method to the profession at large.

"The motive power employed is the 'spring' or elastic force of thin gold bands. My preference is gold of 20 carat to 22 carat fine, and as a rule the thinner the bands the better the result. It frequently occurs, of course, that for special cases or for a special purpose during the progress of any case the band must be doubled in thickness, but this fact does not change the rule as stated. The pressure exerted by the bands is gentle but constant, and the teeth upon which they operate are moved rapidly, with only the slightest inconvenience to the patient. No plates are used, the fixed points for the application of the motive power being supplied by such of the teeth as are suited to the purpose.

"The method of application is in a general way as follows: The fixed points having been determined, the tooth or teeth to be regulated are connected to them by means of a thin gold band. In selecting the fixed points care should be taken to choose teeth which will offer greater resistance to the force to be applied than those which are to be moved will. The band is then manipulated so as to form it into a spring or series of springs so adjusted as to bear most powerfully on the misplaced tooth. Thus, suppose a projecting superior central incisor is to be drawn inward to align properly with the remainder of the teeth in the arch. A continuous gold band embracing the first molars on both sides is fitted around the outside of the arch. With a dull-pointed instrument like a burnisher the ribbon is then pressed into the interstices of the teeth over which it passes, thus forming it into a series of small springs. The incisor being the most prominent point will naturally be most affected by the pressure exerted by the springs, and in a short time it will be found to have moved away from the band so that it is no longer affected by the tension of the springs. As soon as this occurs the apparatus is removed, the ribbon is annealed, straightened, and a small portion, say a thirty-second of an inch, as may be required, is cut out of it. The ends are then soldered, and the appliance is replaced upon the teeth, the connecting band being formed into a spring as before. Tension is thus kept up until the tooth has assumed the desired position.

"In treating this case I aimed to compass four principal points: (1) the destruction of the 'peakedness' by producing a broader or more oval arch; (2) the reduction of the projecting teeth to their proper position; (3) the improvement of the articulation; and (4) the closure of the space caused by the loss of the right superior central.

"Fig. 1 is the general plan of the apparatus.

"A band was applied, clasping the first molars on both sides, and passing around the cuspids and behind the incisors. A wooden wedge was placed between the incisors and the band, and springs formed by pressing the band into the interstices between the cuspids and bicuspids, cutting and readjusting as before.

"Fig. 2 shows a somewhat more complicated apparatus than any of those previously described. It was used in a case where the right central overlapped the lateral. It illustrates how the method which I advocate may be applied to turn a tooth where the force must be applied directly across the mouth. After the necessary room was provided, this fixture was applied. It accomplished its work in four days, after which a retaining device was applied, consisting of a simple band, clasped tightly around the central which had been rotated, and provided with wings tipping on the left central and under the right lateral."

W. H. S., in the *Cosmos,* 1886, page 327, under *Seamless Collars,* called attention to a new use of these:

"They may be employed in the construction of regulating fixtures; for instance, to rotate a central incisor, take a fine wire and wrap it around the tooth close to but not under the gum, and cut the wire so that its ends exactly meet to measure the circumference of the tooth. Straighten the wire without stretching it; find its equal in length on the collar diagram, and select the medium width collar numbered under that line. Take a piece of thick gold plate, shape it like Fig. 3, and solder it to the collar as seen in Fig. 4, using only solder enough to unite the end of the lever, without flowing any solder over the collar to prevent it from fitting close on the tooth. Dry the tooth, smear its neck all around with oxyphosphate cement, and force the collar over the tooth so that the lever will be in position to be pulled by a ligature, or rubber ring, after the cement has

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

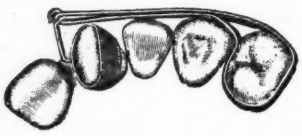

Fig. 5.

Fig. 6.

Fig. 7.

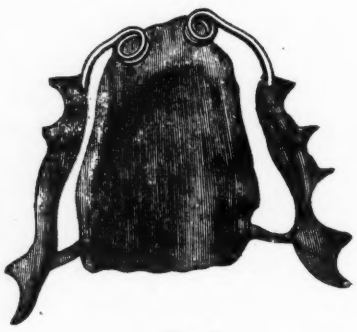

Fig. 8.

become hard, which should take at least ten minutes. The applied fixture is shown by Fig. 5. A bar regulator that is to be anchored to molars or bicuspids may be likewise soldered to collars, which can then be cemented on the anchor

teeth; or the bar may be adjustably connected with the collars, which are then fixed by cement on the teeth. Such fixed collars also serve as fulcra for jack-screws, the points of which will take on the metal of the collars so as not to slip, and yet leave the enamel uninjured.

"For cutting the collars to conform to the cervical curves, an engine corundum point or Herbst rotary file will serve the purpose."

Garrett Newkirk in the *Dental Cosmos,* 1886, page 601 contributed *Something About Regulating* and *Regulating Appliances.* He made use of the vulcanite apparatus based on the so-called Coffin spring as illustrated in Figs. 6, 7, and 8.

Isaac B. Davenport. Before the New York Odontological Society in April,

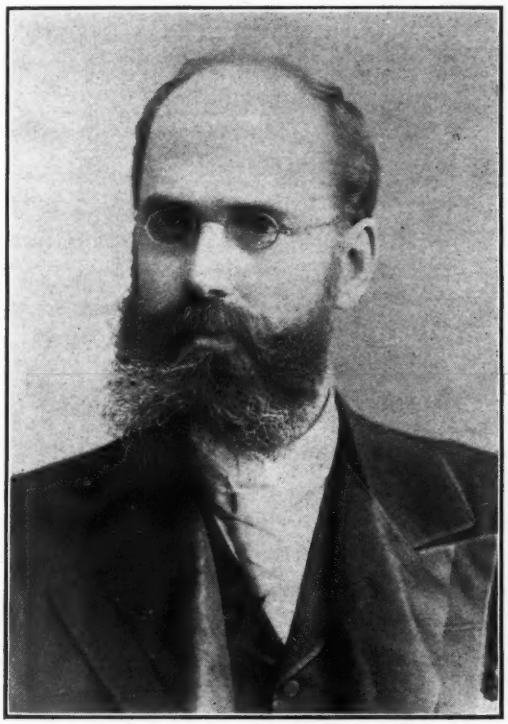

Fig. 9.—Dr. Isaac B. Davenport.

1887, Dr. Davenport read a paper on *The Significance of the Natural Form and Arrangement of the Dental Arches of Man, with a Consideration of the Changes Which Occur as a Result of Their Artificial Derangement by Filing or by Extraction of Teeth.* In 1891 before the American Dental Society of Europe, Dr. Davenport amplified his views in regard to what constitutes correct or normal articulation (occlusion) and the importance of trying to secure this occlusion in all regulating procedures.

In these papers we find for the first time a determined declaration that only by re-establishing normal occlusion can we hope to secure permanent results in orthodontia.

The profession had passed through the experience of and discussion upon Dr. Arthur's method of filing teeth on their approximal surfaces to prevent the extension of caries, and the practice had for some years been discontinued. So,

also, the once common practice of extracting certain teeth, usually the first permanent molars, either to prevent approximal decay or for the purpose of relieving a crowded condition of the arches, had for years been discussed and had come to be largely abandoned, but both practices had been considered and discussed from the standpoint of a desire to benefit the teeth in a general way and to promote their efficiency.

The relation which such filing or extraction might bear to the efficiency of the masticatory apparatus as a whole had not yet been publicly considered, and it was the object of Dr. Davenport's paper to discuss this relationship and point out its great significance. While probably not so considered by its author, it was in very truth an epoch-making paper because it brought to light fundamental facts which had hitherto been overlooked and which, by virtue of their importance, opened the way for marked changes in dental procedures. After presenting the anatomic features of the individual teeth, their relation to one another and the manner in which the occlusion of the upper and lower teeth served the best purposes of speech and mastication, Dr. Davenport proceeded to show how any change of form in any of the teeth, or the loss of one or more teeth, so disturbed the normal relationship as to greatly lessen their efficiency, favor decay, and produce inharmony of the features. After showing numerous plaster models, divided so as to expose the occlusion of the inner cusps of the side teeth as well as the outer ones after their relationship had been altered by extraction and their efficiency consequently lessened, he says:

"But why extract at all? For, besides the loss of important organs we shorten the bite, contract the mouth, disturb the facial expression and secure at least an arrangement of the teeth less favorable for their preservation than existed at first.

"While admitting that under unusual conditions slight extraction may sometimes be resorted to with favorable results, he strongly condemned the practice in general and makes the following significant declaration: 'I am forced to believe that far more irregularities have been caused by extraction than could have been corrected by extraction.' "

Dental Cosmos, July, 1887, page 413:

"Nature had furnished man with two dental arches, so formed and so placed in relation to each other as to be best supported at every point, while permitting all the movements necessary for the perfect comminution of his food.

"Each side of both arches, upper and lower, is furnished with its double row of molar cusps, so arranged that the outer, lower row works between the two upper rows, and the inner, upper row works in the irregular groove between the two lower rows.

"The double cuspid arrangement ceases at the angle of the mouth by the suppression of the inner row of cusps and the modification of the outer row into cutting-edges.

"This suppression of cusps prevents an interlocking which would defeat the normal movements of mastication.

"The upper incisors shut past the lower perhaps a little more than the height of the molar cusps. This permits of the cutting movements of the incisors without too much striking of the cusps. (See Figs. 10 and 11.)

"When the teeth articulate well, the lateral arrangement of cusps and furrows permits the greatest freedom of motion with the least separation of the grinding surfaces. (See Fig. 12.)

"The palatal surfaces of incisors and cuspids are so directed, and have such relations to the inclines of the molar cusps, as to permit contact at different planes of the surfaces.

"Finally the general arrangement of the surface inclines throughout the mouth is such as to permit antagonism of the teeth over from about three-fifths to the entire extent of the dental arches, on every plane of articulation (except

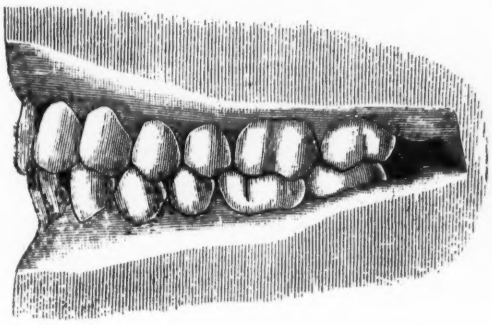

Fig. 10.

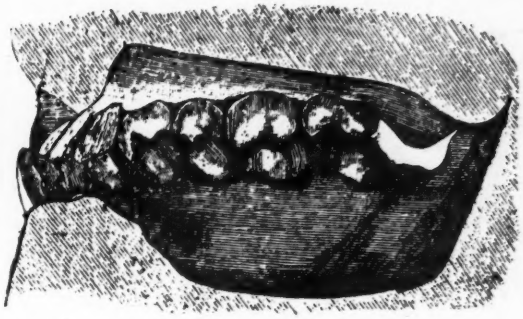

Fig. 11.

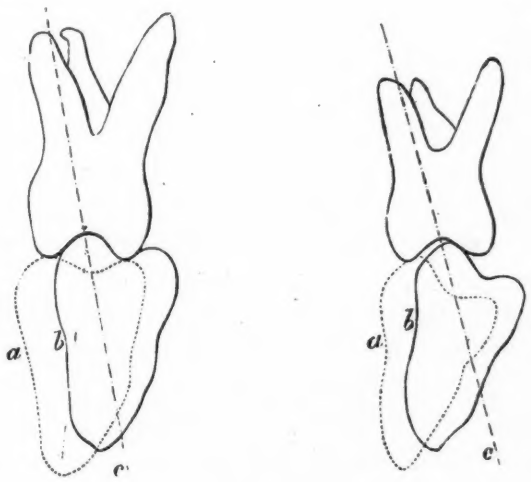

Fig. 12.

for the first part of the cutting motion), and to afford the greatest amount of contact surface for the articulation of food.

"One appreciates the beauty of the general relation of the articulating surfaces as one notes the effects of wear upon the teeth. For example, as the cusps wear down the lower jaw moves forward, and the inner surfaces of the upper incisors become thinner and thinner. When the flat surfaces of the molars alone remain, the cutting edges of the incisors, which projected over the lower teeth, have also been worn away, and we have the characteristic grinding surface called 'double teeth' all around.

"So far our attention has been directed to an ideal dental apparatus taken as a whole, but in its various divisions there is an equal beauty of adaptation of

means to ends, and each part is essential to the working of the whole as is any part of a finely-constructed machine.

"First, we find the arches divided into thirty-two portions, each portion a tooth, having that form, size and strength best adapted to its special office in the completed arch. Each tooth forms with the jaw a compound lever, intended to transmit its proportionate amount of force from the masticatory muscles to the object in contact with its grinding surface, the fulcrum being at the dentomaxillary articulation. The free end of each tooth antagonizes with two teeth of the opposite arch, while it is supported laterally by contact with its fellows, at the point where support is most needed, which is near the articulating surface. Several teeth are thus involved in every important act of mastication; and all are so interlocked and bound in by the articulation and lateral contact that the greatest grinding power is secured, while the strain upon a single tooth is reduced to the minimum. (See Fig. 11.)

"The division of the arches into separate teeth permits the elasticity necessary for the dental apparatus, lessening the danger of shocks and accidents; but its principal object seems to be to allow the slight movement essential for the accommodation of the irregular-shaped masticating surfaces to hard substances in process of reduction. This elasticity is rendered more positive by the inclination of the axes of the teeth, instead of being stubbornly fixed in a vertical position. (See Fig. 12.)

"The inclination of the teeth in one portion of the arch is exactly compensated by an opposite inclination at another portion or else by the inclination of the antagonizing teeth, and so tends to preserve the general form of the arch Thus, we find that the upper molars are inclined outward, the lower molars inward, and the lower cuspids outward. All the teeth are inclined forward just sufficiently to overcome the opposite forces exerted by the orbicular and buccinator muscles.

"When we examine the structure of the teeth we find nature not less wise. The hard, resisting, nonsensitive enamel exists not only on articulating surfaces, but covers the entire crown down to the gum attachments, as though intended as a barrier against those corroding agents whose greatest havoc is upon the more highly-organized substructure of the teeth.

"Attention is invited to these facts, as they have a bearing upon some of the dental practices of today.

"While analogy teaches that nature's form and arrangement of the dental organs are those best fitted to preserve them, evolved as these organs were under the general law of adaptation according to the need, it is true that diseases have appeared which oftentimes have overcome nature's provisions; but as we have only just begun to learn the causes of diseases, we can hardly jump to the conclusion that man has so changed all of his conditions that nature is disposing of his dental organs, nor can we suppose that he would be better adapted to his present conditions by extraction of teeth, or by so filing the teeth as to secure for them isolation and such a conical form as was necessary during his reptilian stage of evolution. This position is strengthened by practical experience and observation, which prove not only the wisdom shown in the form and arrangement of

the dental organs, but that this form is today the best form known in which to preserve the teeth and their usefulness.

"While it is not pretended that the teeth can usually be saved by any easy method, and without care on the part of the patient, yet, notwithstanding the old doctrine that 'contact is always dangerous,' I am fully of the opinion that they may be more easily saved by the preservation of their normal functions; and to do this we must imitate the form of perfect teeth, and their manner of support by *firm contact* with one another, however 'dangerous' that may *seem* to be."

EXTRACTIONS CONSIDERED

"If any *one* tooth be extracted from the above-described ideal dental arches, with their *perfect articulation* (excepting this *one* be from among the six lower front teeth), there will occur no important change in the position of the other teeth: the space will remain nearly the same, as the remaining teeth will be held in position by occlusion of the opposite jaw.

"If one of the *lower incisors* is lost, contact will again be secured by flattening of the lower arch, with the appearance of overprominence of the upper front teeth; or, the entire lower arch will, because of loss of central support, drop inward and become narrower

"This will be accompanied by a similar narrowing of the upper arch, and the forcing forward of the upper incisors and cuspids.

"Never after the eruption of the second molars can extraction of first molars be considered other than a misfortune.

"After the first molars have been extracted the enormous strain of mastication is brought to bear upon the unsupported second molars, whose yielding sockets allow them to tip till they touch the bicuspids. The time required for this result varies from a year or two in young persons to several years, after late extractions of strongly-set teeth.

"The upper molars rotate upon their axes and tip forward till the outer corner of the second molar touches the middle of the distal surface of the bicuspid, while the anterior approximal surfaces of the third molars rest in the concavity of the distal surface of the neck of the second molars. The articulating surfaces of each, reduced to one or two points, do not permit of any proper grinding movement. During the time occupied by the closure of the spaces mastication has been difficult, for added to the defective grinding surfaces is the great discomfort caused by the irritation of the gums by hard substances, and by the strain upon the sockets of unsupported teeth. The changed relation of the second and third molars renders their cleansing difficult, and when decay occurs, as often happens, it is most difficult to treat, especially when it appears in the mesial surfaces of the third molars.

"After late extractions the teeth are often found so braced in their manner of contact, and so much tighter than they ever are when in their natural positions, that it is difficult to pass even fine waxed silk between them.

"If the author of the expression that 'contact is always dangerous' made his study and observation upon such cases as this, there was a show of reason for his conclusions. But the fact is that the cause of recurring decay in such mouths is not *contact,* but the *changed relations of the teeth,* which, besides impairing their functions, *renders cleanliness extremely difficult* if not impossible.

"But why extract at all? For, as is shown above, besides the loss of important organs, we shorten the bite, contract the mouth, disturb the facial expression, and secure at last an arrangement of the teeth less favorable for their preservation than existed at first.

"It is not denied that in some cases decay is lessened between certain teeth during a part of the time that the spaces exist after extraction; yet I am inclined to think that the temporary advantage which any given space may afford is overbalanced by the greater danger that it offers when it is *nearly closed,* or while the teeth are *loosely in contact.* At this time food easily wedges between the teeth and requires *extra* efforts for its removal.

"In uncleanly mouths we often find decay in the well-open spaces, for food left to ferment in contact with the teeth will cause decay as soon upon surfaces not in contact as it will between those that are in contact and even sooner if quantity of fermentable products is a factor in the problem. Now, if extraction were practiced to prevent contact, it is a failure, for there has been contact all the time between many of the teeth, and finally we have it between all. The few spaces that were secured—say between bicuspids and cuspids—only existed for a time, and perhaps fortunately if the patient were not cleanly.

"Really there seems to be but one excuse for the extraction of the first molars: If their structure were so bad that they were sure to be lost later in life, we have done well in choosing a time for their extraction when the spaces will close with the least tipping of the teeth, and with the least derangement of the grinding surfaces.

"We need not hope to improve deformities at the front of the mouth by the extraction of the first molars, when there is a marked forward inclination of the front teeth, including the bicuspids. The overcrowded front teeth will usually retain their position, owing to the increased bracing caused by the shortened bite. But if such overcrowding is at all relieved, it can only be by a forward movement which increases the forward projection of the arches, and a production of a deformity worse than the one sought to be corrected.

"If the deformity consists simply of a too great forward projection of the upper arch, this projection will only be increased by the loss of the first molars, for owing to the shortened bite the forward strain upon the front teeth will be increased. After such teeth have been drawn back into their desired positions by the use of appliances they will drop forward into their former positions, because the natural forces will continue to act after the patient has tired of retaining plates and their accompanying evils.

"Those who followed the description, at the beginning of this paper, of the form and inclination of the teeth in relation to the forces acting upon them, must see to what a mathematical certainty the matter is reduced. So, if one takes the trouble to acquaint himself with a given case, he may safely predict what form the arch will take after certain extractions shall be practiced.

"One hardly needs to consider the results of extraction of any other than the first molars, since these teeth have been made to bear the penalty of most dental sins, as well as sins of dentists.

"While admitting the value of extraction as a means of correction of certain irregularities of the teeth, I am forced to believe that far more irregularities

have been caused by extractions than could ever have been corrected by extraction."

In the above review Davenport showed the principles of perfect articulation, illustrating same not only with models but by diagrams. In the article found in the *International Dental Journal, January,* 1892, under *Articulation of the Teeth,* Davenport says:

"One may recognize that a defect exists without recognizing all that it involves. In order to realize the real import of an imperfection one must know what perfection is, how manifest, and what it implies, otherwise the attempt to correct faults will often result simply in changing one defect for another, perhaps a worse one.

"We benefit our patients in proportion as we make their teeth approach the standard of perfection, and this can not be done blindly and without a knowledge of what a correct articulation is and what it is able to accomplish, so it seems absurd to hear the statement that 'we always have to do with imperfect articulations, and therefore the perfect standard is of no use to us.'

"That argument ought to be made use of only by those men whose vision is so short that they go cutting and digging about the mouth with perhaps the one noble idea of tooth salvation, but apparently regardless of what the teeth were made for; but theirs is not 'whole salvation' which our Methodist friends would say 'brings happiness as its fruit,' but rather the miserable inheritance of unending repentance.

"Nature never loses sight of perfection. Deformities and useless variations are eternally destined to die out sooner or later, and the fittest survive. In the slow process of evolution is one abiding faith.

"The standard of perfection of an organ can never be lowered or diminished so long as its functional need exists.

"While there are probably few perfect articulations, there are many that are imperfect; yet it is possible to learn what is perfect and what tends toward perfection, by observing articulations which most nearly answer the functional requirements; in time one comes to detect the discordant elements which, eliminated, leave a correct idea of perfect articulation.

"Antagonism seems to express the prevalent idea of articulation; but antagonism is just what is most objectionable in an articulation.

"In order to be well articulated the teeth must be regularly placed and correctly inclined.

"The most common irregularity of the teeth is the irregularity of the position of the masticating surfaces, and yet but little attention is given this matter in works upon irregularities, the attention being mostly confined to the deviations of the external curves or alignment of the teeth; yet if the former were attended to, the latter would necessarily be corrected, and more permanently so than is usually the case.

"When teeth are regular and well articulated, they remain so because the forces and resistances are evenly balanced.

"On the other hand, as the articulation is made up of a series of perfectly balanced inclines, it follows that when anything removes one surface, whether an extraction, decay, operation, or badly constructed regulating or other ap-

paratus, undue force falls upon other inclines with the certain result of changing the position of the tooth or teeth.

"I have hardly ever found what I could call a good articulation a few years after teeth had been extracted, and the same is true when the teeth have been cut away between, or when the cusps had been carelessly removed while finishing fillings in the grinding surfaces.

"Largely on account of bad articulation irregular teeth tend to become more irregular. Growth may improve some cases, but so far as a bad articulation goes it is always unfavorable to regularity of the teeth.

"Much harm is done by the use of regulating appliances which change the articulation without improving it, and it is almost a universal fact that unless an improvement can be made in an articulation there will be no permanent improvement of the irregularity.

"Finally, the articulation is the only permanent retainer to be depended upon.

"The teeth will move till they find the best contact that circumstances can offer, and that movement often never ceases, because the forces never find equilibrium.

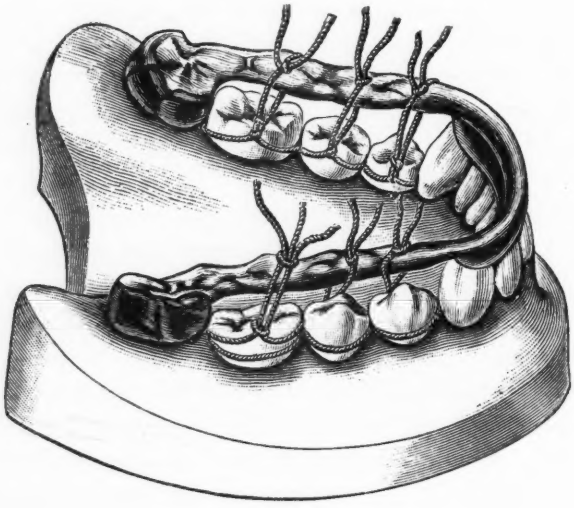

Fig. 13.

"Before disturbing the articulation of a fixed irregularity, it is best to consider whether such disturbance can be overcome, and the articulation again made as good; if not, the chances are that the result will be worse than the original condition, and for the ultimate result we must wait not only 'till the teeth become firm,' as we say, but until they cease to move.

"There is much yet to learn in regard to the meaning of the elevations, depressions, overshutting, shelving, interlocking, binding, curves, and inclines of the articulation, in their relation to biting, cutting, tearing, crushing, and grinding movements of mastication.

"In the treatment of our patients it is hoped that if we can not all see our way clearly upon this matter, that we may at least see far enough not to make the articulations worse by our operations than they are when brought to us."

In the *International Dental Journal,* 1893, W. S. Davenport contributed an article entitled *Twisted Wire for Regulating Teeth.* Fig. 13 shows the method employed before the American Dental Society of Europe, Aug. 5, 1895.

(To be continued.)

DEPARTMENT OF
ORAL SURGERY AND SURGICAL ORTHODONTIA

Under Editorial Supervision of

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BONE GRAFTING IN UNUNITED FRACTURES OF THE MANDIBLE—WITH SPECIAL REFERENCE TO THE PEDICLED GRAFT*

BY PERCIVAL P. COLE, F.R.C.S.ENG.,
Late Hunterian Professor, Royal College of Surgeons; Honorary Surgeon, King George Hospital;

AND CHARLES H. BUBB, L.D.S.,
Honorary Dental Surgeon, King George Hospital

THE evolution of the bone graft as applied to ununited fractures of the mandible is a matter of considerable interest. Since the outbreak of war orthodox opinion has undergone a radical change. The extent of this change can be gauged by a perusal of the *Transactions* of this Section. At a meeting of this Section in 1916 bone grafting as a means of dealing with nonunion was mentioned merely for the sake of academic completeness. Practically, it was either ignored or regarded as a manifestation of somewhat ill-advised activity on the part of surgical visionaries. Compare this view with that deliberately voiced last session by the then president of this Section. In March, 1918, Mr. J. H. Babcock summed up the position thus: "It is evident from the collection of cases on view this evening that the operation of bone grafting as a cure for ununited fractures of the mandible has passed beyond the experimental stage into the region of assured success in a very large proportion of cases. But such success can only be expected when a surgeon and a dentist work in close and sympathetic collaboration, with the full understanding of each other's aims and efforts. No surgeon dealing with fractured jaws can afford to neglect this operation, and no ununited mandible should be given up as hopeless until it has been given a fair trial."

*Read at a meeting of the Section of Odontology of the Royal Society of Medicine, November 25th, 1918. Published by special permission of the British Medical Journal.

Unfortunately this finding, based on the evidence of results, has been by no means universally adopted. Thus, in an article in the *British Journal of Surgery,* July, 1918, which deals with the treatment of cases at a recognized jaw center, this statement is made: "Fibrous union is treated by a suitable prosthetic appliance." It is obvious that the treatment of nonunion has not been standardized. Opinion tends to the condemnation of the *non possumus* attitude that characterized the earlier days of the war, but procedure is neither settled nor consistent.

How important it is to formulate a consistent, clear-cut policy must be apparent to all. The treatment of ununited fractures is essentially a peace problem. The exigencies of warfare can no longer be invoked to extenuate procedures that fall short of the best, either in plan or in execution. Throughout four years of war the simpler cases have been dealt with to a finish. The clear supernatant fluid has, as it were, been drawn off, leaving a precipitate of remediable or hopeless nonunions. How numerous are these cases, and how have they been dealt with? We are unable to answer those questions, but certain facts can be adduced to show how necessary it is that they should be answered. As to their number, information is very scant, but certain figures are available. Northcroft had 10 per cent of nonunions in his series; Forty had 16 per cent, and we, counting all types of cases, had 11 per cent. It may fairly be estimated that nonunion occurs in approximately 10 per cent of all mandibular fractures. If this be so, the number of ununited fractures must be considerable, for over 1,300 cases have been treated at the King George Hospital alone. The constant appeals made for statistics bearing on this question have, as noted, evoked but little response.

That nonunion can only be remedied by operative measures is an admitted fact. To what extent and with what success surgical intervention has been invoked it is impossible to judge, for the only series of cases other than our own is that published by Platt, Campion, and Rodway. This much is certain, that for at least two years after the outbreak of war isolated attempts only were made to deal surgically with these lesions. As a rule, the attitude assumed by those in charge of these cases was expectant and noncommittal, but occasionally active hostility was encountered.

Taking all these circumstances into consideration, one must conclude that a large number of ununited fractures have been discharged from hospital, their treatment being allegedly completed. Let it be remembered that no surgeon would regard nonunion of any other bone as a satisfactory termination to treatment. Let it be remembered, too, that the disability from an ununited fracture of the mandible tends to become progressively greater as teeth now used for abutments are lost; also, that the maximum of disability will obtain at an age when the compensatory powers of the individual are on the wane. Remembering these things, we maintain that every case so situated should be carefully reviewed, and that wherever possible the condemning dictum should be revoked. Let us quote a striking passage from Mr. John Galsworthy in the first number of *Reveille*:

"Be not trustees of your own departments first, and servers of the general purpose second; keep the restoration of the wounded man in the forefront of your minds and sacrifice everything else—even your own dignities—to that. Restoration of the man and nothing else matters."

The benefits derived, the chances of success, the penalties attaching to failure, the risk incurred, the methods to be employed—such questions as these must be investigated, and upon the answer to them will depend that settled conviction which must necessarily precede the consistent adoption of any fixed plan of treatment. In short, a verdict, favorable or otherwise, must be based on the evidence of results.

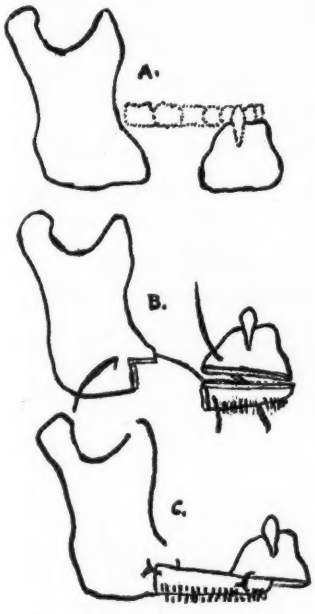

Fig. 1.—A, Diagram of fracture. B, Graft cut. Posterior fragment freshened and wire passed. C, Graft fixed in position. Pedicle shown schematically.

It is on that account that we have brought for your inspection every available case, irrespective of their condition or the date of operation. These cases number twenty-three, and include nineteen pedicled grafts and four free transplants. In addition, cases have been shown which are regarded as suitable for one or other of these grafting operations.

The proportionately large number of pedicled grafts will be noted. We have employed this method in thirty-four cases. Free transplants have been employed in twelve cases only. The latter method is only adopted when a pedicled graft can not be utilized.

The pedicled graft operation has been described in previous communications,[1] and it is therefore not necessary to recapitulate the details. The use of this method has been extended to the utmost, and as a result certain improvements have been introduced. It is now usual to perforate the graft posteriorly (Fig. 1, A, B, C). The fixing wire is passed through the substance of the bone, instead of surrounding it, and thus firmer and more reliable contact is obtained. At times both ends of the graft are perforated. Experience has shown that a much more bulky fragment may safely be detached than we were wont to use. For both of these improvements we are indebted to Captain Tainter of the United States Medical Service, whose valuable assistance has been placed at our disposal.

Another point not previously emphasized is the rigidly aseptic method employed. Skin margins are guarded by towels clipped to the edges of the wound; all knots are tied with forceps and no handling of wound or graft is at any time permitted. Some may maintain that such technic is totally unnecessary and savors of surgical pedantry. It is, however, well to remember that the standard aimed at is rarely attained and that within limits it is impossible to err on the side of a too rigid technic. That the precautions taken are well within these limits is shown by the fact that the operation rarely takes more than one hour and a quarter and is often completed in fifty minutes.

We propose briefly to summarize the conditions our experience shows to be necessary to permit the performance of a pedicled graft operation.

1. *Site of Fracture.*—The loss of tissue must implicate the horizontal portion of the bone—that is, the lesion must be situated at or in front of the angle.

[1]Hunterian Lecture *British Journal of Surgery*, July, 1918. Transactions of the Odontological Section, Royal Society of Medicine, March, 1918.

2. *Size of the Gap.*—This should usually not exceed 4 cm. In favorable circumstances it is possible to cut a thick, well nourished graft of 6 cm. in length, and a gap of 5 cm. (before trimming) may thus be dealt with, if end-to-end union is resorted to.

3. *Condition of the Soft Parts.*—It is necessary that the tissues of the submaxillary triangle should be free from scar tissue on the side from which the graft is to be cut. It is extraordinary how frequently this area escapes even when the soft tissues of the face are extensively damaged.

Nothing has been said as to the more precise situation of the fracture because a lesion on one side can be dealt with by a graft taken from the opposite side. The ability to do this has been demonstrated on several occasions. It entails a considerable dislocation, the definition of a long pedicle, and a consequent tendency to displacement. In two cases of this nature with maximum gaps the results, though good, have not up to now been entirely satisfactory. In both cases the lower jaw was edentulous and atrophic, thus seriously limiting the amount of bone detachable; in both cases the operation was undertaken through scar tissue, and in neither case were perforating wires utilized. In extending the application of an operation a limit must be reached, and reached, in our judgment, it has been in the cases detailed.

It is impossible to refrain from commenting on the technical difficulties forced upon the surgeon by the edentulous jaw. The cases here tonight show how rapidly these jaws become frail and atrophic, militating thus against grafting by any method and adding to this nutritive difficulty the technical one of efficient fixation of the fragments. We are glad to note that, among others, Major Pickerill has joined his protest to those we have made from the earliest period of the war, and we take this opportunity to reiterate our conviction that the multiple extraction of teeth is a policy that should be abandoned.

A brief statement may be made as to the progress of these cases. Without exception, they have been out of bed before the skin stitches have been removed. Progress has been throughout uneventful; an alveolar abscess occurred in one case and stitch sinuses in two others. The splints are removed in from ten to twelve weeks according to the size of the defect. At this time a slight "give" is noticeable corresponding to the plastic stage that occurs in the union of all fractures. As a rule, this bending phenomenon gradually disappears, and firm union ensues in from four to six months. Occasionally union fails at one or the other end. A secondary wiring operation is then undertaken. This has been invariably successful, and the graft when exposed has been indistinguishable in appearance from other living bone. The overlap originally present permits of this secondary operation being performed without any sacrifice of occlusion.

An interesting departure is the treatment by a pedicled graft of two cases in which previous free transplants had considerably diminished the gap but had failed to determine union. A case of this description was grafted in Switzerland. He came to us with free mobility but with a gap that could readily be bridged by a pedicled graft. A sinus was present at the time of operation but no untoward effect has been noted.

It has been stated that 34 cases have been dealt with by this method. In 23 the result is known, and of these 21, or over 90 per cent, have been completely successful. In the two remaining cases the patients themselves are thoroughly satisfied but we can only regard their condition as considerably improved; they are accounted as failures in the appended table of results. The pedicled graft operation permits the utilization of a portion of living bone, possessed of its own blood supply, passing to it from a natural musculo-fascial pedicle. The method of Cavalié, for which similar claims are made, can not justly be regarded as a pedicled graft operation. The results support this contention, for they have been far from satisfactory.

Free transplants are only employed when conditions do not permit the use of a pedicled graft.

Apart from the question of technic, the factors that determine the success of a free transplant may be dealt with as follows:

1. *The Condition of the Soft Parts.*—The operation should not be attempted in the presence of frank or concealed sepsis. We always allow three months to elapse after obvious sepsis has disappeared. As the graft is not vascularized from the bed in which it is implanted the vascularity of the bed is not of direct importance. All that is required is that the soft tissues shall be pliable enough to permit nice adaptation of the graft, and well nourished enough to maintain their vitality when sutured, and thus prevent the introduction of sepsis from without. Excision of puckered and adherent scars is frequently necessary, and plastic operations should be so planned that exposure of the bone ends may be accomplished without undue risk of opening into the mouth.

2. *Condition of the Fragments.*—The size of the gap is not material as an isolated factor. We have successfully dealt with a case in which the graft, 7 cm. in length, extended from the facial vessels on one side to those on the other. The condition of the fragments is most important, both from the point of view of reparative power and the facilities afforded for efficient immobilization. The ends of the bone always tend to become atrophic and sclerosed. This process is progressive, and hence any undue delay seriously diminishes the chance of success. The age of the patient, too, is a most important factor. Delay, then, on both these counts it to be deprecated. So convinced are we of this that we urge operation after a reasonable trial of more conservative methods. This is a question that vitally affects the welfare of the pensioner. The treatment of old nonunions brooks no delay, for every day that passes steadily diminishes the chances of success. The edentulous fragment is an even more burdensome difficulty than in the case of the pedicled graft. If we were asked to state what single item in the treatment of jaw cases had given rise to the most difficulties, disappointments, and failures, we should unhesitatingly answer—the indiscriminate extraction of teeth.

3. *The Graft Itself.*—This may be taken from the tibia, rib, crest of ilium, or scapula. In short the graft may be taken from any bone, the choice depending on accessibility and the physical disposition of the portion removed to conform to the shape and size of the gap and to the methods of fixation employed. The presence or absence of periosteum is not material, as our cases conclusively demonstrate. The results obtained do not compare favorably with those by the pedicled graft

method—hence our preference for the latter. In the case of the long bones, Hey Groves has recently published a series of 34 cases with complete success in 55 per cent. In the series of Platt, Campion, and Rodway the results were extremely satisfactory, and the authors are to be heartily congratulated. The osteo periosteal method of Delagenière has, according to reports, given extremely good results. A series of cases grafted in this manner was the subject of a paper by Lebidnisky and Virenque at the Inter-Allied Conference. These same authors discuss the method very fully in the book recently published by them. Further information is required as to the size of the gap that can thus be dealt with successfully.

Of our own 12 cases the result is known in 10, and of these, 7 have been completely successful, giving a percentage success of 70. Splints are removed in from three to six months. Progress is slow, and firm consolidation can not be expected in less than six months to a year.

We have questioned the earlier patients in both groups as to their present function. Ten replies only have been received. All state that the jaw feels solid; five of these (all pedicled grafts) are on ordinary hard diet; four of these state explicitly that they "can eat anything." As regards the other five the replies are disappointing. One can eat meat if stewed (free transplant); the other four (two pedicled and two free grafts) can only eat meat if minced. This question of subjective evidence is beset with difficulties. When the evidence is positive—when a man states that he can eat anything, that statement obviously can be accepted without demur. The same can not be said of negative evidence. In several cases we know, from observation, that such negative statements have been incorrect. Unsupported negative statements are open to question when at variance with what clinical examination would lead one to expect. The reasons for this are obvious, and will be appreciated by all those present who have knowledge of the working of the Workmen's Compensation Act.

From conversation with our most intelligent patients we are convinced that disability is a muscular failing. When it is remembered that many of our cases have been under treatment for two years, coming to us after a year or eighteen months in splints, this muscular disability is scarcely to be wondered at.

A man with a compound fracture of the femur can perhaps get about fairly well at the end of six months; one does not expect him to be able to play football. Football to a femur is as hard food to a jaw, and we think that, even with union, some functional disability will frequently be long-standing. Ability to masticate is restored invariably to the sound side first, an ability which, in the presence of mobile nonunion, is impossible. On the affected side ability is delayed—the jaw, as it were, walks with a limp.

The position as regards all cases of nonunion dealt with by us may be tabulated thus:

NATURE OF OPERATION	NO. OF CASES	RESULT KNOWN	FAILURE	SUCCESS
Plating	2	2	2	0
Wiring	20	20	1	19
Pedicled graft	34	23	2	21
Free transplant	12	10	3	7
Operation abandoned	3	3	3	0
Total	71	58	11 = 19%	47 = 81%

No selection whatever has been exercised; we have operated on every case submitted to us. It will be noted that the balance is heavily weighted against ourselves. Thus three cases are counted as failures, in which the physical conditions found by exploration rendered, in our judgment, any further steps impracticable. Again, no "improvement" column has been included, though in most cases improvement has been considerable. In no case has the patient's condition, general or local, been adversely affected by operation. Finally, there has been no mortality, and no complication of a nature to cause alarm.

SIXTH ANNUAL MEETING OF THE PACIFIC COAST SOCIETY OF ORTHODONTISTS

THE Sixth Annual Meeting of the Pacific Coast Society of Orthodontists was held at the Palace Hotel in San Francisco, California, on May 12th and 13th. The following program was presented:

President's Address....Dr. B. Frank Gray, San Francisco, Cal.
Discussion opened by Dr. John R. McCoy, Los Angeles, Cal.

Orthodontia Observations..Dr. Wm. Power, Seattle, Wash.
Discussion opened by Dr. H. F. Sturdevant, Portland, Ore.

Art and Orthodontia....Perham W. Nahl, of the University of California.
Discussion opened by Dr. Robert Dunn, San Francisco, Cal.

A Consideration of Normal Arch Form, and Some of the Methods of Determining It.....Dr. James D. McCoy, Los Angeles, Cal.
Discussion opened by Dr. Allen H. Suggett, San Francisco, Cal.

Vertical Development....Dr. Robert Dunn, San Francisco, Cal.
Discussion opened by Dr. William Cavanagh, Portland, Ore.

Radiography in Orthodontia....Dr. Leland E. Carter, San Francisco, Cal.
Discussion opened by Dr. Charles C. Mann, Seattle, Wash.

The Relation of Periodontia to Orthodontia
Dr. A. W. Ward, San Francisco, Cal.
Discussion opened by Dr. James D. McCoy, Los Angeles, Cal., and Dr. D. Arthur Johnston, Los Angeles, Cal.

American Orthodontists..Dr. A. A. Solley, San Francisco, Cal.
Discussion opened by Dr. C. O. Engstrom, Sacramento, Cal.

The Co-relation of Orthodontia and Rhinology.....Dr. E. W. Alexander San Francisco, Cal.
Discussion opened by Dr. B. Frank Gray, San Francisco, Cal.

CLINICS

Lingual Wire.....Dr. Allen H. Suggett, San Francisco, Cal.

Molar Attachments for Lingual Arch....
Dr. C. O. Engstrom, Sacramento, Cal.

Showing a Corrected Occlusion.....
Dr. A. W. Ward, San Francisco, Cal.

The Use of Linen Thread in Movement of Teeth and for Temporary Retention
Dr. Frank C. Pague, San Francisco, Cal.

The Ribbon Arch....Dr. John R. McCoy, Los Angeles, Cal.

Use of .020 Lingual Arch Wire in Preventive Cases.....*Dr. A. A. Solley*
San Francisco, Cal.

An Attachment for Biscupid Bands with the Ribbon Arch.....Dr. Chas. C. Mann, Seattle, Wash.

DEPARTMENT OF DENTAL AND ORAL RADIOGRAPHY

Under the Editorial Supervision of

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B. FRANK GRAY, D.D.S., San Francisco—C. O. SIMPSON, M.D., D.D.S., St. Louis.

It is the object of this department to publish each month original articles on dental and oral radiography. The editors earnestly request the cooperation of the profession and will gladly consider for publication papers on this subject of interest to the dental profession. Articles with illustrations especially solicited.

COOPERATION OF THE ORTHODONTIST AND THE RADIODONTIST*

BY CLARENCE O. SIMPSON, M.D., D.D.S., ST. LOUIS, MO.

IN common with other professions and vocations in this age of specialization and efficiency, the practice of dentistry is becoming divided into limited fields or specialties. Orthodontia and exodontia by priority, are generally accepted by the profession and well established in the conception of the laity. In recent years have come prosthodontia, periodontia, pediadontia, and the future will prove and enhance the claims for a distinct field of radiodontia. Although there have been many facetious quips said and written about medical specialists and the interminable visits from one to another for treatment, this development has unquestionably resulted in progress which would not otherwise have been attained. Similar advantages have resulted from restricted study and practice in dentistry. Orthodontia has developed from a haphazard practice of extraction, crude appliances, and a sublime faith in the assistance of Nature, into a marvelous science by which the unfortunate victims of malocclusion have function and symmetry restored. Only a few years ago the extraction of teeth was an important and exasperating phase of every dental practice. Without going back to the period of the turnkey and punch when the blacksmith, the barber, or the medicine man officiated in this capacity, just recall memories of the "cowhorn" forceps and "crowbar" elevators. Reminisce upon the root fragments which the patient was assured would be exfoliated, the "gum freezing" applications which only produced frostbite, the postoperative hemorrhages which caused more alarm than postpartums, and those cases which "took cold" in spite of swathed heads. While many dentists are loath to admit that any one can get a tooth out "slicker" than they and profess keen enjoyment in

*Read before the Alumni Society of the Dewey School of Orthodontia, St. Louis, Mo., March 6-8, 1919.

"pulling" teeth, more and more of this work is being done by the exodontist. Dentists and patients have learned that by perfect anesthesia and skillful technic, most difficult operations are performed without suffering or serious injury, to the advantage of all concerned. Compare the service of the prosthodontist to that of the average general practitioner, many of whom have deteriorated to the level of sending a "mush" bite and an impression in a stock tray to the commercial "slaporatory," to be supplied with a product having a high polish as its chief virtue. These are examples of specialization in dentistry and proof that the maximum efficiency can not be attained by one who attempts all types of operations. Since this tendency is increasing and promises to result in further division and subdivision, claim is made for a branch of dental diagnosis, in which history, clinical signs, and pathology are used in conjunction with the greatest single diagnostic aid, radiographic examination.

The term *radiodontia,* being of comparatively recent adoption, may require some explanation. It is defined as the art and science of making and interpreting radiographs of the teeth and adjacent structures. Etymologically it is vulnerable to the criticism of having its origin from both Latin and Greek, but it euphoniously combines *radio* and *odontia* and greatly simplifies the term of dental radiographer and diagnostician, and conforms to the accepted terminology of orthodontia, periodontia, and exodontia. It includes far more than the mechanical procedure of radiography, in that the intelligent examination and interpretation requires professional education, clinical experience, and special study. The qualifications of a competent radiodontist are:

A practical knowledge of electricity, and sufficient mechanical ability to manipulate and maintain radiographic apparatus at its maximum efficiency.

Sufficient experience in photographic technic to secure the best results in the dark room work.

A professional education which includes more pathology, histology, and bacteriology than in the past has been provided in the dental curriculum.

Clinical experience derived from the general practice of dentistry, the longer and more creditable the better, since too many men begin the practice of a specialty without the advantages of experience in general practice, or after having been unsuccessful from incompetency.

An extensive study of radiographic films and plates to develop proficiency in recognizing normal structures and detecting errors in technic and variations from the normal.

A sixth sense which may be called a histopathologic intuition to reason from cause to effect and conversely.

A broad professional spirit with the greatest consideration for the welfare of the patient, assistance to the dentist, and cooperation with the physician.

An absorbing interest and enthusiasm for the work with unlimited confidence in the value and future development of the practice.

With these qualifications the radiodontist may be of inestimable service to the dentist or orthodontist, in obtaining radiographs which disclose most information, in correctly interpreting the record, and in consultation upon proper procedure. The appreciation of radiographs which disclose the most information

comes from careful discrimination and the extensive use of them. To the beginner anything which shows the roots of the teeth is such a revelation that little more is expected, and the majority of dentists accept without complaint, radiographs from which a diagnosis can not be made. Interpretation is precarious enough with the best radiographic records obtainable, and when attempted with less becomes little more than clairvoyance or a guessing contest. Many men are confident of their interpretation just as all were a few years ago, and some now are of their root canal operations. They meet with no difficulties in interpretation because it so often consists only in observing ill-fitting shell crowns, the length of root fillings, and "abscesses." This is not greatly exaggerated, and the lack of study given to the matter has compelled the notation of the areas on the film mount after several were returned for location. If not enough thought is utilized to locate teeth by form, roots, and restorations, what can be expected for anatomic landmarks or pathologic conditions?

While the quest of the orthodontist is usually for specific information concerning unerupted teeth, which an adequate radiographic examination will disclose without exhaustive interpretation, the radiodontist when supplied with the clinical history has a great advantage in the number of radiographs seen and the knowledge of the conditions under which they were produced. A report or conference brings an interchange of ideas which may direct the attention of the orthodontist to unobserved details and supply him with information as to distances and angles. The radiodontist should have a keen interest in, and keep informed upon, the progress in all branches of dental practice, and there is every reason why his association and scientific interest should qualify him to cooperate and confer with the orthodontist. In this connection the following is quoted from an unbiased authority, the United States Government, in the book of instruction to the Medical Advisory Boards for draft examination: "The x-ray while not infallible is a most important aid in the diagnosis of disease. It gives information that can be obtained from no other source. It is therefore advisable in cases of suspected conditions for the registrant to be given the benefit of an x-ray examination, provided a competent roentgenologist is available. The interpretation of roentgenographic findings is of the greatest importance. It is often better to have no x-ray examination than to have it done by a man of limited experience, or with an inferior roentgenological outfit."

The difficulty and inconvenience of referring the patient to the radiodontist is often raised as an objection, but by correct methods, this can be minimized unless the distance is prohibitive. The first step is to impress the patient with the necessity of the examination. In doing this you have the choice of two methods, or a combination of the two; viz., either explaining the advantages by an educational talk, or arbitrarily stating it is imperative for the diagnosis or operation. While x-ray examination is utilized by dentists to a limited degree, too often as a last resort, daily opportunities of its intelligent use are neglected when time and labor could be saved, and better service rendered. The physician, surgeon, internist, in fact all medical specialists, make far more use of the radiographs than dentists, quite likely more radiodontic examinations are made upon the advice of physicians than dentists, and as it has been truly said, the dentist who needs radiography most is the last to take advantage of it.

The cooperation of men in the limited fields of dental practice is of mutual advantage and a great influence in the progress of dental science. We all may learn from men who are intensively studying and operating along lines so closely related as are the specialties of dentistry. Aside from selfish interest in direct gain, the fraternal spirit promotes technical advancement, and the prestige of the profession in the estimation of the laity. The radiodontist in his examinations should consider himself an associate of the orthodontist, with the success of the treatment and the welfare of the patient at heart, and should utilize thought and ingenuity to obtain the maximum amount of information.

The orthodontist should encourage this by requesting specific information from the radiodontist and supplying clinical history, both of which are essential for a thorough examination and an interpretation. It is often difficult to obtain the desired data from the patient or parent because of the mass of irrelevant, inaccurate, and imaginative clinical and family history which the average individual volunteers upon the slightest pretext. (Reference, Cobb's *Speaking of Operations.*)

In the harmonious relationship of coworkers, the orthodontist and radiodontist will find some difficulties of practice made easier; they will derive inspiration for greater proficiency through a mutual technical appreciation; and they will render a more efficient service to the patient, which should be the goal of professional practice.

RELATION OF ROENTGENOLOGY TO PREVENTIVE DENTISTRY*

By Harold O. Hansen, D.D.S., Chicago, Ill.

THE roentgenogram is becoming each year, more of a necessity in the dental office, and with the oral hygiene movement rapidly developing, the demand is becoming still greater.

In the beginning, the roentgenogram was employed to detect broken-off roots, impacted and unerupted teeth. Later, as the knowledge of local infections became more widely known, the use was extended to root canal work. The uncertainty and dissatisfaction of work on pulpless teeth has led to more serious thought and consideration for the welfare of the patient, who has been subjected to long tedious root canal operations, the result of which has been at best doubtful.

To avoid these unpleasant features we have directed our endeavors along other channels and find our only solution of the problem in preventive dentistry, which is the preservation of the original tooth structure.

In the normal mouth which contains a full complement of teeth it is estimated that there is approximately twenty-two square inches of peridental membrane surface. Outside of the dangers to which one is subjected by infections around the apices of teeth, the condition of the peridental membrane is the best indication of the safety and cleanliness of the oral cavity.

The roentgenogram affords the only means of studying this attachment and for this purpose we need fine detail and more definite angles than ever was needed in routine dentistry. It is necessary to develop a technic with uniform results. For this purpose in my opinion there is but one type of machine and one kind of tube. When one becomes accustomed to studying radiograms of this class they are more qualified to properly interpret them. These exposures are made with a definite spark gap and milliamperage. So many dental pictures are made with machines which have not the capacity to properly expose a positive film, so the negative or fast films are used with a great sacrifice of bone detail. Nearly three-fourths of all dental pictures are taken on high frequency outfits necessitating the use of these fast films. Although this shows an effort on the part of the dentist to improve, it is nevertheless a great handicap, as these pictures are unsatisfactory even for the experienced roentgenologist to interpret, and for the unexperienced are almost useless. Fortunately, however, with the demand for high grade radiograms the manufacturers are producing more efficient machines and the use of the other types should be discouraged.

With the desire for better roentgenograms and a more careful study of the same has been created an almost new profession, which has for its purpose the abolition of all irritation and infection for the oral cavity, and putting the mouth in condition to be kept clean. These men should be properly called oral hygienists; and the time is rapidly approaching when dentists will divert their time from routine dentistry to this new field. This grand movement is here to stay

*Read before the Fourth Annual Meeting Western Roentgen Society, Chicago, November 20-21-22, 1918. Published by permission of the *Journal of Roentgenology*.

and already its momentum is so great that it would be impossible to stop it, and will yearly increase until our profession will be looked upon as the greatest in the healing art.

Dentistry was created to fill a long felt want; but the only object of dentistry was to restore lost parts, and any benefit that was derived systemically was accidental and merely an incident compared with the replacement of lost teeth.

Dr. Mayo a few years ago at a meeting of the Chicago Dental Society made the statement that the next great step in medical progress in the line of preventive medicine must be made by the dentists, and added the question, "Will they do it?"

Dr. Mayo saw the great possibility and his only reason for asking, "Will they do it?" was due to the fact that dentists as a class are so absorbed in their routine restoration work that to change their line of thought to a higher and more noble pursuit is a slow process. I can answer Dr. Mayo's question and say, "They will do it," but there must be a complete revolution of ideas in the dentist's mind, and he must begin to treat cause instead of effect.

Professor Pickerell, in a recent article, lays emphasis on the interdependence existing between various physiologic functions, and urges upon us the necessity of widening our outlook when dealing with diseased conditions of the mouth and teeth. The disorganization or loss of function of one organ will assuredly lead to the disease of another in the same or allied system.

The mouth is the greatest harbinger and the most extensive breeding place of all pathogenic microorganisms, and here is the origin of nearly all contagious and infectious diseases.

The fact that mouths of each generation are poorer than those of the preceding generation has caused great alarm, and conditions can only change when the organized efforts of the oral hygiene men educate the public to demand dental services which will tend to abolish this deplorable state of affairs, and when there is created in dentistry a full realization of its responsibilities. Then dentists will be saving lives instead of teeth.

Most individuals have a great regard for personal cleanliness and very religiously attend to these duties, but the mouth, the most important portal of entrance of microorganisms, is sadly neglected. To give one some conception of the tremendous number of bacteria in the mouth, Dr. W. Parker Harrison, of Brighton, England, records in the British Dental Journal of May, 1915, the following experiment:

Each of twelve toothbrushes was used once, rinsed ten times in a tumbler of water, and after standing for twelve hours all the bristles were removed with sterile forceps and the organisms counted in the usual way. In eight out of the twelve cases more than a million organisms were found, such a quantity of bacteria is comparable with the number of organisms found in sewerage, which is twenty-six million per cubic centimeter, and in one-sixth of the counts made on sterile tooth brushes, used only once, the number on the brush exceeds this. The volume of liquid held by a toothbrush that has had the superfluous water flicked off, as was done in these experiments, is not nearly as much as I. C. C., which renders the comparison all the more to his disfavor of the toothbrush.

These experiments were carried out by the patients suffering from peri-

dental diseases, but it was also found by four experiments on an apparently healthy mouth, that almost as large a number of bacteria were left on the toothbrushes.

The above experiments allow a statement that the millions of toothbrushes in this country are in a most disgusting and septic state; a condition of affairs especially to be deprecated and if possible alleviated; where septic processes are in operation in the mouth, the pyogenic organisms left on the toothbrush today are reinoculated into the mucous membrane of the mouth tomorrow.

When we consider the large percentage of men disqualified for army service in all its branches, and in the more special lines, such as aviation, nearly 95 per cent are rejected as physically unfit, only one man in twenty physically balanced for this service. This fact alone should startle the medical profession and prompt them to analyze the underlying cause, and institute ways and means of abolishing to a great extent this percentage of physically unfit; and the mouth, the fountain head of infection, should receive the first attention.

A study of these facts should not alarm us, it should inspire hope. By ignoring the truth or by refusing to look into it because of the grim depression which accompanies the contemplation of this state of affairs merely betrays our unfitness to deserve a better fate.

Medical men as a class are not interested in dentistry, so do not acquaint themselves with mouth conditions, and so do not realize what class of work is conducive to mouth cleanliness. The only way to be sure is to remove all infection.

The maintenance of a clean mouth precludes the possibility of a rise of secondary pathologic phenomena, which menace, not only the health, but the very existence of the individual.

The secondary phenomena which include some of the most serious lesions known to pathology, have now been proved to be dependent in primary force within the oral cavity, to an extent heretofore undreamed of.

It is obvious that we can no longer consider proposed dental restorations in the light of primary function; but to look beyond this and consider it with relation to the formation of focal infections, and general systemic effect.

When we find that a certain type of restoration can not be accomplished without the formation of possible foci, we must definitely eliminate that type of restoration. When we find that it invariably produces a derangement of cell function and a lowering of tissue resistance, that type should be considered obsolete; no matter how thoroughly it fulfills the esthetic and functional requirements.

Pulpless teeth have been looked upon with doubt ever since the advent of the roentgenogram and more and more are we beginning to realize the fact that they are dangerous and should never be left in the mouth. The fear dentists have of being called radical has kept them from openly announcing their stand on this subject. But in my humble opinion the radical man is the one who allows his patients to carry infected areas of unknown and uncertain virulence, capable of doing inestimable harm, thus jeopardizing the health and happiness of this individual. He is the radical one, as the conservative man always plays safe.

Medical and dental literature has been filled with articles on this subject and many have reported results which seemed encouraging, but one can not build on a weak foundation, and those same teeth which seemed to improve under treatment and apparently were safe, have become reinfected hemolytically due to the fact that the area over a root apex will not remain sterile for any definite period of time or by any method of treatment.

Dr. Gilmer made this statement recently at a meeting of the Chicago Medical Society, "I extracted a large number of pulpless teeth and secured streptococcus viridans from almost every case. Alveolar abscesses, when some of the apical peridental membrane has been destroyed may be cured temporarily by sterilization of the root canal, but it is for a very limited period, because there will be reinfection sooner or later; the organisms being carried to the dead cementum by the blood stream."

The pulpless teeth should always be looked upon as a foreign body within the bone. No dentist is justified in allowing them to remain in the mouth even though they are well camouflaged by gold crowns and other unpardonable appliances, which are always a direct irritation, unclean, and help maintain a luxuriant mouth flora.

If only a small percentage of devitalized teeth were infected we would still be far from justified in allowing them to remain and jeopardize a patient's health merely for the sake of a tooth. Infection is measured by quality and not by quantity and some of the larger areas discernible about root ends may be causing less systemic disturbance than a small area unnoticed by the x-ray, which may be a very virulent infection. The roentgenogram at best is only a shadowgraph and is never a clear photographic expression of a pathologic condition. Although the best diagnostic means available and a great blessing, still should not be relied upon too much.

Health is the greatest blessing a man can have and when one deliberately and intentionally neglects to remove infection he is as much a criminal as the man who takes life. Before the introduction of the roentgenogram into dentistry one felt justified in allowing these broken down undesirable teeth to remain as they were ignorant of the dangers attached to his neglect, but now, no one is excusable and any one who will casually examine a radiogram and pass an opinion as to whether a certain dead tooth is or is not infected, is doing a great harm. One is merely guessing and has no positive scientific assurance of this fact. I will be glad to present a paper at some future time showing the change both in the numerical and differential blood count brought about by properly cleaning up a mouth.

One of the prerequisites for an oral hygiene man is that he must have an ideal. The man that has no ideal, no matter what his occupation, is dangerous, and the man that pretends to have an ideal and does not live up to it is a hypocrite.

Our ideal is a mouth free from bacteriologic, mechanical, and chemical irritation, and one in which the tissues of the mouth are normal in every respect and each tooth surface highly polished and free from restorations of any description.

There should be no decay, as it only means neglect either on the part of the

patient or the dentist. Without the initial introduction of caries into tooth structure there would be no dead teeth. If half the concentration and effort which is devoted trying to make one dead tooth safe was spent in prevention, there could be ten teeth made beautiful, safe, and free from decay. Most patients have a limit on both the time and money they can spend on dental services, and too often this time and money is spent on dead teeth and the good ones neglected until they are decayed and broken down in a similar manner.

There is no individual who can not get along no matter how many teeth he has extracted as they can be replaced by some sanitary removable appliance, with better results, from the standpoint of the patient's health. This necessitates the removal of pulpless teeth together with those afflicted with pyorrhea beyond the point where they can be saved.

Mechanical irritation is caused by fixed bridgework, crowns, and overhanging margins on fillings, especially the amalgam filling, and should never be used.

Chemical irritation includes the bacterial plaques made up of food particles bound together with the mucin of the saliva, and finds lodgement between teeth and around unpolished overhanging margins of fillings; causing decay, due to the disintegration of the enamel by lactic acid formed by the decomposition and fermentation of the mucilaginous plaques. This is, however, too long a story for discussion here.

We are often asked by dentists, "How can we meet the requirements of the oral hygienists?" The answer is always the same. Remove all devitalized teeth, never place crowns or fixed bridgework in the mouth, and never put in amalgam fillings. Devote your time to preventive work.

When this is done there will be a feeling of satisfaction that the conscientious man is entitled to enjoy.

DISCUSSION

Dr. O. E. Lanphear.—These clear clean slides and the able papers on dental roentgenology are an inspiration to me and beyond criticism. Roentgenographic localization of a needle or a root by the use of a piece of metal held at the point of puncture or at the mouth of a fistula, by means of adhesive tape, establishes a point from which to measure. Unless this precaution is taken, it might be difficult for the clinician to find the offending particle.

One can elaborate upon this method by having the piece of hard metal, the shape of an arrow, cut from thin unyielding metal, lying in a given direction and plane, held in place over the fistula, on dry gums by collodion, while the part is radiographed in intersecting planes. The nearer the intersection approaches a right angle, the more definite the position of the foreign particle.

For the clinician's convenience, in an edentulous mouth, we establish a position with a fixed block on which to bite. To this block we attach the metal arrow in juxtaposition to the fistula, then two exposures are made as before. The operator can then replace the block for measurements, getting the same information he would were the arrow held in a fixed position over the fistula, on the dry gums, by collodion.

The localization and delineation of impacted third molars by Dr. Simpson's superior technic is the finest thing I have ever seen. It was both clever and skilful. He gives the clinician clear, first-hand information.

I agree with Dr. Hansen when he says, "Three-fourths of the fast dental films are poor," but in my opinion, the fast film is maligned.

There are many possibilities of errors in the wide range of technic where the element of time is the predominant factor, as in nervous children, the fast film will often show superior results.

ABSTRACT OF CURRENT LITERATURE

Covering Such Subjects as

ORTHODONTIA — ORAL SURGERY — SURGICAL ORTHODONTIA — DENTAL RADIOGRAPHY

It is the purpose of this JOURNAL to review so far as possible the most important literature as it appears in English and Foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

ORTHODONTIA

Apical Movements of the Teeth. L. Valderrama. La Odontologia, 1918, xxvii, No. 12, p. 625.

One of the difficulties confronting the successful practice of orthodontia is due to the fact that the most favorable time of life is in early childhood, namely between four and six years of age. In private practice, before starting on a course of orthodontic treatment, the dentist must first make sure of the normal support and intelligent cooperation of the parents or guardians. In children who about the age of six years show an absence of interdental spaces, a future malposition of the permanent teeth is to be anticipated, for the alveolar processes at this time must already feel the stimulus of the budding permanent teeth and under normal conditions, with proper occlusion of the temporary teeth, the latter will become spaced so as to leave room for the permanent teeth. From the age of four years on, there should exist a minimum distance of 28 millimeters between the cervico-lingual borders of the second upper temporary molars, a smaller interspace suggesting an incipient anomaly of occlusion. The slowest and most difficult movement for the orthodontist to bring about, in order to correct dental malpositions, undoubtedly consists in the vestibular version of the apical portion of the teeth, for it involves a change in configuration of the entire alveolar process, and in a general way of the bone in which the teeth are inserted. What is required is, not merely a simple movement of the teeth, but a change in shape of the bone, and thereby of the patient's physiognomy. This change in the facial contours takes place very gradually, good occlusion finally resulting from the establishment of proper equilibrium of all the parts concerned. Seeing that the profile is the anterior boundary of the face in unilateral projection, it must be kept in mind in altering the position of the teeth that this limit represents the best obtainable improvement. The remainder of the face will at the same time be brought nearer to the normal standard, for there exists a very close relation between the profile and the other zones into which the face has been divided by progressive orthodontists.

In cases where apical movement is indicated, in youthful individuals whose bones are not yet strongly calcified, and when the causes of the malocclusion have not produced a very obvious anomaly, briefly when the treatment is largely prophylactic in character, a variety of more or less simple appliances may be utilized. The new apparatus of Angle hardly exerts enough tension to move the apex of a canine tooth of the ordinary size, without great effort and loss of time. In the author's opinion, the apical movement of teeth can be accomplished by means of a practicable apparatus devised by him, which works continuously, without interruption, and automatically enough to render frequent visits to the dentist unnecessary. The power of this apparatus can be regulated so as to fit the requirements of a given case. Three illustrations serve to explain the principles on which this orthodontic device is based and to show the manner of its application.

The Value of the "No Good"—Malocclusion. D. H. Stewart. **Western Medical Times, 1919, xxxviii, No. 9, p. 363.**

Malocclusion should be considered as much of a symptom as any symptom —to use the author's own eloquent phraseology—and by its correction the removal of other symptoms should be rendered possible. In the presence of malocclusion, the sternum, the ribs and the spine are not normal, or even approximately so. A common accompaniment is adenoid hypertrophy, together with the fairly constant presence of nasal abnormality. If the upper jaw is much distorted, then every cavity in the head is also distorted, with the possible exception of the ear, the function of which is but too often ruined by a catarrhal process that never would have started were it not for the bad ventilation of adjoining cavities and their membranes.

The ignoring of a basic fact, like the great importance of the relation of a good mouth to bodily health, in no way lessens the importance of the fact itself. Therefore, perhaps, one of the greatest benefits to mankind would follow from a public health service that insisted that every child from five to seven years of age should have a mouth that is either in good working order or is put in that condition.

Disease and Facial Expression. I. W. Voorhees. **The Trained Nurse and Hospital Review; April, 1919.**

The author points out that the importance of recognizing the possibilities of permanent deformities in the faces of growing boys and girls can not be overestimated. Certain facial irregularities represent a part of our evolutionary inheritance, in the form of the ape-like long upper lip, the wide prominent mouth, the short chin, the high cheek bones and the receding forehead. A more serious condition sometimes occurs in the form of cleft palate and hare-lip combined or separate, and due to an arrest of embryologic development. Such defects should be repaired by a skilled operator at the earliest possible moment so as to

guard against an increase is size of the gap. Narrow upper jaw and high, V-shaped roof of mouth are usually referable to a superabundance of adenoid tissue or other nasal obstructions. All these patients are habitual mouth-breathers in whom as a result of the mouth being always open, the lower jaw drops, becomes elongated and tends to over-ride the upper jaw. The orthodontist finds a most promising field for his activity in the correction of these deformities.

ORAL SURGERY

Military Plastic and Oral Surgery. C. E. Black. The Journal of the National Dental Association, 1919, vi, No. 3, p. 211.

In the fourth of a series of lectures reviewing some of the recent literature, delivered before Officers' School of Plastic and Oral Surgery, Northwestern University Dental School, 1918, the author discusses the surgery of the jaws, plastic operations, fractures, dislocations, and anesthesia, on the basis of contributions scattered through the literature. He found the general surgical literature on this subject rather scanty, while the dental articles are too technical and do not contain a sufficiency of general practical considerations applicable at the front. Quoting extensively from Blair's *Surgery and Diseases of the Mouth and Jaws,* he says with special reference to plastic operations that in the early days of the war, where extensive separation of the skin and soft tissues of the face accompanied fractures of the jaw bones with loss of substance, the inclination was toward immediate closure of the facial wounds by suture, little or no consideration being given to early correction of the bony displacement. As a consequence the cases finally came into the hands of the oral and dental surgeon with the soft tissues tensely united over the deformed bones, and the difficulties to be overcome in correction were enormously increased. It has now become a well-recognized principle that no attempt should be made to suture the soft parts with the idea of closing a gap until such time as union of the fractured parts in correct relation is well under way and permanent splints are adjusted. By keeping the mouth cleaned and reducing displacement, there will be less disfigurement to rectify. It is desirable to wait until scar tissue has formed.

The Treatment of Maxillary Fractures in Serbia, 1914-15. A. Poulio. The Dental Magazine, London, January-February, 1919, p. 1.

In this paper (read at the Inter-Allied Dental Congress held in Paris, November 10-13, 1916, and translated from the Comptes-Rendus of the Proceedings) which is based on the author's work in the capacity of surgeon and of dentist, on three hundred and forty-five maxillary fractures, he enumerates three different methods of fixing the fragments, now in use: (1) The splint in metal wire, fixed upon the fragments by the aid of rings and ligatures. (2) The splint in cast tin, in three parts, which are united by two hinges. (3) The splint in

one piece which covers all the teeth, and is constructed of cast silver, or struck in German silver, and strengthened by wire. Excellent results are obtainable with each of these methods. The first and second procedures were employed by the author in person, his preference being for metal wire splints as the mode of fixation. The splint is composed of two rings and an arc of metal wire. As teeth for anchorage, the molars were ordinarily employed. If the fragments are properly replaced and the splint correctly adjusted, perfect articulation is obtained, analogous to that existing before the injury.

Summarizing his experience, the author points out that in treatment of fractures of the maxillæ we require: (1) Collaboration of the surgeon and the dentist. (2) Avoidance, at the commencement of the treatment, of operations which are not absolutely necessary. The treatment ought to be conservative. (3) Accomplishment of the perfect fixation of the maxillary fragments in normal occlusion. (4) An operation (cleavage) in fractures of the mandible which have become consolidated in false positions, and the fragments must be fixed anew in their proper position. (5) In a case where after perfect fixation, suppuration has ceased and where three months later osseous consolidation has not occurred, it will not occur. We have, therefore, to do with "pseudoarthrosis." (6) Pseudoarthrosis ought to be treated by the removal of the fibrous tissue and bringing together the extremities of the fragments and suturing them. (7) The only treatment of pseudoarthrosis of the maxilla according to scientific rules which gives complete success is bone-grafting.

Chin-cap and Skull-cap Replacing Inconvenient Bandages in Cases of Fracture and Mutilation of the Maxillæ. V. Guerini. The Dental Magazine, London, January-February, 1919, p. 11.

In this paper which was read at the Inter-Allied Dental Congress held in Paris, November 10-13, 1916, and translated from the Comptes-Rendus of the Proceedings, the author describes a chin-cap devised by him, made of aluminum plate and furnished with holes. Its form is such that it is capable of containing the entire human mandible, and it can be widened or narrowed to suit individual requirements. In order to maintain the chin-cap constantly adherent to the fractured or mutilated mandible, even when in a state of rest during sleep, it is united to a small wire skull-cap by very thin elastic threads attached to little hooks of metal affixed to the extremities, or alternatively by rubber rings. The chin-cap which is supplied at its upper edges with several holes serving for points of attachment and retention, remains continuously adherent to the mandible with a slight pressure from below upwards caused by little elastic cords which pass from hooks on the skull-cap to the holes of the chin-cap. The apparatus serves equally well for healing maxillary fractures and for fixation of the fragments, the two dental arches remaining continually in close contact. The skull-cap, as well as the chin-cap, may be employed independently. If the wounded or mutilated patient to whom the whole apparatus is applied shows injuries on some part of the face or of the cranium, the dressings may be maintained by a slight and constant pressure of the elastic cords of the apparatus if the injuries are situated on the face, and by the skull-cap if the injuries are on the cranium.

Conclusion.—The chin-cap and the skull-cap are of incontestably practical utility; they succeed in fixing fractured maxillæ, maintain the dressings always against the mandible, the face and cranium, and thus avoid the possibility of the wounds being infected. (2) They are easy to sterilize. (3) The chin-cap and the skull-cap are both very light and e'astic, and their weight does not exceed a hundred grams. (4) The chin-cap being pierced, and the skull-cap being gauzed, transpiration is accomplished in a normal manner. (5) The application is easy and within the competence of all, and the apparatus is constructed in a shorter time than is needed for a bandage. (6) The circulation of the blood is more free, the wounds heal more rapidly, the cosmetic result is better, and the hygienic conditions are superior to those obtaining in the customary methods of treatment with bandages.

Plastic Prothesis in Face Mutilations. L. Rousseau Decelle and Ch. Dubost. La Restauration Maxillo-Faciale, 1919, iii, No. 1, p. 15.

The authors emphasize that the merits of the plastic prothesis are not sufficiently recognized, for a variety of reasons. The procedure consists in the taking a mould of the face, the reconstituting the missing part by wax, the casting it in paste with a gelatinous basis, and the putting it in place by means of a suitable cement. Of course, these plastic gelatine protheses are not durable and can not be expected to last more than three days, but the patient can be trained so that the renewal of his prothesis becomes an automatic act for him. About ten protheses may be cast in advance, so that the very simple work which is necessary will have to be done only three times per month. In order to guard against irritation of the skin through the cement, the authors recommend a concentrated dextrine solution instead of resinous and ether varnishes. It goes without saying that these plastic protheses must always come after the completion of all surgical operations, and that they are only recommended in those cases where it is absolutely impossible for some reason or other to accomplish a satisfactory repair, or when the cosmetic results obtained by surgery are inadequate. Finally, patients while waiting for an intervention often gladly avail themselves of the advantages of their prothesis, which permits them to mingle with their fellows without attracting attention.

Conduction Anesthesia. A. Chornet. Revista del Centro Estudiantes de Odontologia, 1918, v, No. 10, p. 415.

Conduction anesthesia, for its successful application, requires accurate knowledge of the topography of the nerve supply to that portion of the body which is to be anesthetized. This form of anesthesia readily lends itself to stomatological surgery, where it may prove highly serviceable. The technic of conduction anesthesia of the anterior dental nerve, which sends branches to the upper incisors and canine teeth, and at the same time of the sphenopalatine nerve, is very

simple, consisting merely in the application, in the anterior region of the corresponding nasal fossa, of a small tampon of absorbent cotton, the size and shape of an almond, soaked in a 1:20, or better, 1:10 solution of cocaine, combined or not with adrenalin 1:1000. Solutions of novocaine, stovaine, and various cocaine substitutes, may be employed for the same purpose. The anesthesia is not complete until fifteen or twenty minutes after the application of the tampon. The anterior dental nerve can also be reached and anesthetized by means of injections at the level of the infraorbital canal, where the nerve branches off from the superior maxillary nerve.

Conduction anesthesia of the inferior maxillary nerve can be obtained by placing the anesthetic fluid in contact with this nerve trunk at its emergence from the cranium through the foramen ovale.

The inferior dental nerve can be anesthetized at its entrance into the dental canal, or by the buccal or internal route, or by the cutaneous or external route. At the level of the mental foramen, this nerve terminates in two branches, the mental nerve which passes through the foramen to the skin of the chin and the lower lip, the labial mucosa, and subjacent glandular layer; and the incisor nerve which penetrates into the incisor canal and sends filaments to the incisors and canines of the corresponding side. Through the mental foramen, which is situated at a point external to the inferior maxilla, at an equal distance from the lower border and the alveolar border of this bone, in a vertical line passing between the two bicuspids or through the second bicuspid it is possible by means of a small amount of anesthetic solution to arrest the nervous conductivity of the incisor branch, and probably of the mental branch, thereby obtaining anesthesia of the regions supplied by these nerve branches.

In a general way, it may be stated in conclusion that conduction anesthesia of all those nerves is practicable the trunks of which can be brought in contact with an anesthetic solution.

Pseudarthrosis of the Lower Maxilla. G. Plouvin. La Restauration Maxillo-Faciale, 1918, ii, No. 12, p. 524.

The author reports very satisfactory results obtained in the case of a wounded soldier by means of a saddle apparatus mounted on "knee-pan," with springs which maintain the saddle in the proper position while affording some elasticity. The patient came under treatment with a double fracture of the lower maxilla viciously consolidated to left and destruction of the right lateral portion of the horizontal branch. Rather loose pseudarthrosis extending from the right angular region to the right lateral incisor of the lower maxilla. Imperfect occlusion owing to the vicious consolidation to left and anteversion of the median fragment. The apparatus in two parts, in use in the military dispensatory of the Paris Dental School since the beginning of 1916, proved so serviceable in this instance as to justify its employment in a number of other cases. The good results are accomplished by gradual immobilization until the fragments are in equilibrium. The apparatus is composed of: (1) One silver hame for properly enveloping the teeth for the retention. (2) An inserting saddle of the ascending branch, provided with two strong springs, one external,

the other internal, and mounted on "knee-pan" to facilitate all the movements. When absolute immobilization is obtained (very slowly and by gradually getting used to the same) the only work left to do is to weld the saddle to the hame and to place on this base a block of teeth for the articulation. Thus the apparatus becomes a rigid apparatus in one piece, with supporting surface on the ascending branch.

War Injuries of the Face. W. Rosenthal. (Ergebnisse der Chirurgie und Orthopedie, 1918, x.) Medical Supplement to the Review of the Foreign Press, 1919, ii, No. 3, p. 208.

The necessity of cooperation between the surgeon and the dentist is emphasized by the author, as well as the importance of early treatment in facial and jaw cases. For lower jaw injuries an early splint attachment is recommended which, while allowing the mouth a certain amount of gape, prevents displacement of the fragments. With special reference to free bone grafts for the jaw, the author in discussing the relative advantages of the jaw itself, the rib, the clavicle, the ilium, the tibia, and the metatarsus, as sources of the graft, inclines on the whole towards the ilium and the tibia. Greater importance is attached, however, to the technic than to the source of material for the graft. Preservation of the periosteum is very essential to success, and the periosteum must not be infiltrated when the operation is performed under local anesthesia. He recommends that the graft should be transferred directly to its bed without intervening immersion in fluids, and with a minimum of handling, the periosteal edges being then stitched together with catgut, to which procedure the author attaches great importance. He admits, however, the possibility that the freshened end of the jaw fragment with its medullary tissue may also play a part in the final union of the graft, although regarding this as unproved. There is no limit to the size of the free bone graft, which may be followed by perfect union and proportionate functional result.

Various methods of dealing with salivary fistulæ as a result of gunshot wounds are also described, as well as methods for the treatment of defects of the lips, nose, eyelids, and palate. For the latter, all closure by obturators and dental appliances is rejected, the author maintaining that whatever their size and position, they are capable of being closed by plastic operation.

Extra-oral Expansion Device with Bilateral Grooves for the Treatment of Fracture of the Mandible. E. Morale. La Restauration Maxillo-Faciale, 1919, iii, No. 1, p. 54.

"The object of this apparatus is to spread and to replace in a satisfactory position a fragment of mandible displaced to the median line on account of a fracture with loss of substance which extended from the right to the left cuspid. A special feature of this apparatus is provided by the separate action of each sliding member, which makes possible the movement as desired of the front or the back of the fragment, and to arrest the progress of either end at

any desired point. Since this apparatus is removable it is easily kept clean, the patient can take it off, clean it, and put it back again without any other help, as owing to the tension of the rubbers, the openers find their place themselves. The patient who used it took it off to take his meals and this did not interfere in any way with the progress for the correction. The fracture was a year old, the tissue which had formed was very resistant, and the various screw or spring apparatus which had been previously used produced no result."

The extra-oral expansion device described in the original accomplished in a month and a half a sufficient expansion and adjustment of the parts, with occlusion of the upper and lower teeth, after treatment with a number of other appliances had proved unsuccessful.

RADIOGRAPHY, Etc.

Two Rare Cases of Ossification of Ligaments Recognized Through Radiological Examination. C. Guarini. La Riforma Medica, 1918, xxxiv, No. 11, p. 208.

In a case in which the lower jaw remained movable only in the vertical direction, but to a limited degree, while the ability to masticate was considerably diminished, the author succeeded in demonstrating the ossification of the sphenomaxillary ligament by means of radiography. In another case, ossification of the fibrous articular capsule of the right thigh could be demonstrated radiographically. Without the assistance of the x-ray apparatus, it would have been impossible to render the correct diagnosis in both these cases, as the clinical picture might have been produced by a variety of changes. In the case of the first patient, a soldier who was wounded by a shell splinter in the region of the right ear, the radiological examination showed a shadow apparently due to ossification of the sphenomaxillary ligament. Small metal splinters were present in the surroundings of the ligament. There were no well-marked bony lesions of the mandible and temporomaxillary articulation on the right side. The ossified ligament was identified as the sphenomaxillary ligament on the basis of anatomic and physiologic considerations. The patient's functional disturbances were due to adhesions between the ossified ligament and the ascending ramus of the jaw. The ossified ligament interfered with the action of the pterygoid muscles in moving the jaw forwards and imparting to it movements of adduction and abduction. Cases such as these illustrate the possibility of ossification of ligaments as a result of traumatism in the vicinity of bones.

Electro Medication. W. H. Jordan. The Dental Summary, 1919, xxxix, No. 3, p. 203.

Iontophoresis, also known as ionization, or the driving of particles charged with electricity into the tissues, is advocated by the author on the basis of personal experience as the most dependable and easiest method of treating oral infections, worthy of the most thorough investigation by the dental profession.

The advantages of ionic medication in dentistry are many: It is not in the least painful if the proper current strength is applied, is extremely effective, placing at our disposal a method of reaching deep infections with disinfectants, antiseptics, and sedatives, and is very easily carried out, with a simple readily obtainable apparatus. Marked improvement is apparent immediately and is unmistakable by both patient and operator.

Electrically charged moving particles or ions will not pass through the tissues in a direct line from pole to pole, but will branch out, seeking paths of least resistance. This means the ionization of a wide area and eliminates all possibilities of failure to reach all parts of the lesion under treatment, provided the current is on for a sufficient length of time. Different ions are indicated in different cases. The chlorin ion, dissociated from sodium chloride, or any metallic chloride, has the property of softening and dissolving fibrous or granular growths, such as a granuloma, probably increases phagocytosis, has some antiseptic properties, and without doubt is indicated in the abscessed root where no systemic reactions are apparent, or very little bone destruction has occurred. If chlorin is used in the treatment of suppurative or inflamed conditions, the normal salt and the negative electrode is placed in the canal or pus pocket, and thus the chlorin ion travels into the tissues toward the positive electrode, which is in contact with the body at a more or less distant part.

Radiography Laboratory Points. J. A. Van Brekle. American Journal of Electrotherapeutics and Radiology, 1918, xxxvi, No. 9, p. 260.

The following important paragraph of this valuable contribution deals with a subject of orthodontic interest. Tooth infection and its relation to systemic infection has come into such prominence lately that more and more dental radiography is being demanded. For the physician who wishes to check up on the sources of infection, the ability to do his own dental radiography not only saves time but causes a good deal of first hand satisfaction. Using a chair to which a dental head rest has been attached, the patient's jaw can be suitably placed for exposure. The best size film for general use is the $1\frac{1}{4} \times 1\frac{5}{8}$ inch extra fast. Two difficulties will arise in attempting dental work. First, it will be hard to arrange the film in the patient's mouth so as to cover the roots of the teeth to be radiographed and so as not to curve the film and thus provide for distortion of the image. Try to keep the film flat and push it well up or down as the teeth to be taken are in the upper or lower jaw. In case of doubt as to whether the root is covered or not, put the film in so that the length of the film corresponds to the length of the teeth. Fewer teeth can be taken at one time in this way, but one is more apt to reach the ends of the roots. The second difficulty is found in trying to focus the tube correctly. The plane of the film and the plane of the tooth taken on its long axis will not be parallel, the root being farther away from the film than the crown and thus creating an angle between them. It will be found by experiment that if the ray is directed in a line perpendicular either to the plane of the film or of the tooth, the image will be distorted and of small diagnostic value. But if the ray is directed in a line perpendicular to a plane which bisects the angle formed between the tooth and the

film, a minimum of distortion will result, and this then becomes the direction of choice. In x-raying teeth, a cone of small diameter should be used. If the opening in the cone is quite small, the beginner will find some difficulty in always covering the film with the ray. Continued practice alone will overcome these difficulties of focusing, but the result of a well-focused dental radiogram is so satisfactory that the extra practice is well worth while.

Note on the Use of Ionization in the Treatment of Certain Types of Facial Scars. H. L. Carter and A. D. E. Shefford. British Medical Journal, February 22, 1919, p. 214.

Upon the basis of personal favorable experience in a series of twenty-four cases, the authors conclude that ionization, usually with chlorine ions, is of undoubted value in the treatment of facial cicatrices. The circulation through the scar tends to become reestablished, there is loss of stiffness and adherence, permitting the play of underlying muscles and reduction of the limiting effect of the scar upon the masticatory muscles. This therapeutic measure in their opinion may be advantageously combined with the mechanical procedures of intermittent intraoral gagging and massage. In this experience the results are best when the gag is applied for an hour immediately before treatment. It is recommended, in cold weather to warm the area to be treated with hot water or by the use of radiant heat by means of a small cup reflector for fifteen minutes before commencing ionization. This therapeutic measure was likewise found serviceable in cases where the edges of the flaps, after facial plastic operations, are rolled and thickened, causing retraction of surrounding normal tissue. By increasing. the softness and flexibility, ionization helps to diminish the deformative effects of postoperative facial scars. The treatment of the scars by ionization was found to result in a progressive decrease in their densities and an increased flexibility, both subjective and objective, with marked permanent improvement in ability to open the mouth and masticate. Adherence of the scar to osseous tissue offers greater resistance, and the treatment has to be prolonged in these cases, often for a period of three months or more. The best results were obtained by ionization with sodium chloride as an electrolyte.

Interpretation of Dental Radiograms. G. F. Thomas. The Dental Summary, 1918, xxxviii, No. 12, p. 909.

The limitations of the radiogram in diagnosing dental lesions form the subject of the author's interesting and valuable contribution to odontologic literature. He explains that in view of a variety of factors, the x-ray film alone can not be relied on entirely for all diagnostic data, for it is merely a macroscopic record of the structure and the density of the tissues, or rather a composite of all the superimposed shadows of the infinite number of layers of which the tissues are composed. In interpretation, the thickness of the bone and the overlying soft tissues, as well as their relative densities, must be considered. The first requisite to a good interpretation is, of course, a good film or better still two or more good films of the same region taken from different angles. The essentials

in a good film are good contrast of tissue densities, sharp definition of bone structure and minimum distortion.

The various structures of the tooth (which is the densest tissue in the body) have enough difference in density to show up on a radiogram and permit a distinction between the enamel, the dentin, the pulp cavity and the root canals. Small cavities can be detected, and occasionally a carious process can be discovered within an apparently sound tooth. The first stage of infection is indicated on the film by an abnormally dark area, due to the locally diminished tissue density through absorption of the lime salts. During a period of one to several days, however, according to the author's personal observations, a very intense inflammatory reaction with hyperemia and exudation may be taking place without sufficient variation from the normal density to be demonstrated radiographically. The bone changes in pyorrhea alveolaris are, of course, clearly demonstrated on the radiogram, so that the extent of the destruction of the alveolar process can be ascertained at a glance. When absorption takes place along the sides of the root, the white line normally produced by the compact bony lining of the lamina dura or cribriform plate of the alveolus is obliterated, and a broad zone of osteoporosis indicates the area of involvement. Osteomyelitis of the jaw is characterized by areas of absorption, areas of sclerosis and periosteal new bone formation, the predominance of these various characteristics depending on the stage of the process and the relative degree of reaction.

Cancer of the Oral Cavity, Jaws, and Throat; Treatment by Electrothermic Methods or in Combination with Surgery, the Roentgen Ray and Radium, with an Analysis of 200 Cases so Treated. W. L. Clark, Journal American Medical Association, 1918, lxxi, 1365.

Clark recommends electrothermic methods as best adapted to the treatment of cancer within the mouth. The methods he refers to are electrodesiccation and electrocoagulation. The first method is one by means of which malignant growths of small or moderate size may be destroyed by the utilization of heat of just sufficient intensity to desiccate the tissues, and is produced by monopolar high frequency current. The desiccation method is of advantage when the lesion is localized and a good cosmetic result is desired. Electrocoagulation is produced by a bipolar high frequency current. It is more penetrating and intense in action than the desiccation method. It is utilized to destroy large growths.

The distribution of the cases treated and the results obtained are herewith presented. The areas involved were: upper lip, lower lip, upper jaw, alveolus and hard palate, alveolus (lower jaw) and floor of mouth, tongue, buccal surface, antrum, tonsils, pharynx, epiglottis, larynx, base of tongue, and esophagus, advanced lesions involving several structures in the mouth.

The Role of Focal Infections in the Psychoses. F. A. Cotton. New York Medical Journal, 1919, cix, No. 10, p. 397.

The necessity for very radical treatment of oral infections is insisted upon by the author who has all his patients, on admission to the New Jersey State Hospital, examined by the dentist as soon as possible Every suspicious tooth

is extracted and cultures are taken. When there is any doubt as to extracting the teeth, the teeth are radiographed. After many unpleasant experiences caused by being too conservative, the practice has been adopted to extract every tooth that is at all doubtful.

Instead of resorting to the simple expedient of radiographing the tooth to see whether the root is infected, many dentists unfortunately continue to cap teeth with gold crowns which inevitably aggravate an infection already present.

"Hardly a patient of the better class is admitted to the hospital at Trenton who has not had expensive gold crown and bridge work, and our first act is to tear it all out, for by experience we know that it is infected." Neglected and decayed teeth are not apparently as productive of diseased conditions as capped teeth. When devitalized teeth are either capped, pivoted, crowned, or filled, with a pre-existing infection at the apex of the root, the outlet is closed up and the bacteria continue to proliferate under the ideal conditions furnished by the dentist; they seek an outlet through the porous bone tissue and there gain access to the lymphatic system and migrate to other distant organs. The streptococcus types occasionally invade the blood stream.

In view of the fact that very extensive involvement of the roots of teeth can exist and be the cause of serious trouble without causing any pain to the patient, such infections can be successfully treated only by an expert dentist who realizes the dangers and controls his work with frequent x-ray examinations. Thoma, of the Harvard Dental School, contends that it is impossible to treat successfully these infections by any means, such as ionization or local application, and the author is inclined to agree with him. If the patient's condition is serious, no time should be lost and the tooth should be extracted at once. The x-ray picture in many cases gives only the slightest evidence of the diseased condition, and only when the bone is involved, the abscess being always much worse than it appears to be in the picture. In other cases, in which no serious root trouble is revealed by the x-ray, new granulomatous tissue is sometimes seen surrounding the tooth just below the gum or between the roots of molars, and found on examination to be teeming with bacteria. The author emphasizes the fact that most of the focal infections due to streptococcus have their origin in the teeth, and from this source, in the course of years, the organisms reach remote organs on other structures.

The International Journal of Orthodontia and Oral Surgery

PUBLISHED THE FIFTEENTH OF EVERY MONTH BY

THE C. V. MOSBY CO., 801-809 Metropolitan Bldg., St. Louis, Mo.

Foreign Depots—*Great Britain*—Henry Kimpton, 263 High Holborn, London, W. C.; *Australasia*—Stirling & Co., 317 Collins Street, Modern Chambers, Melbourne; *India*—"Practical Medicine," Egerton Street, Delhi; *Porto Rico*—Pedro C. Timothee, Rafael Cordero 68, San Juan, P. R.

Subscription Rates—Single copies, 50 cents. To anywhere in United States, Cuba, Porto Rico, Canal Zone, Mexico, Hawaii and Philippine Islands, $3.00 per year in advance. Under foreign postage, $3.40. English price: 15/ per annum, 1/6 per number. Volume begins with January and ends with December of each year.

Remittances—Remittances for subscriptions should be made by check, draft, postoffice or express money order, or registered letter payable to the publishers, The C. V. Mosby Company.

Contributions—The editor will be pleased to consider the publication of original communications of merit on orthodontic and allied subjects, which must be contributed solely to this journal.

Opinions—Neither the editor nor the publisher hold themselves responsible for the opinions of contributors, nor are they responsible for other than editorial statements.

Reprints—Since it is not desirable to hold type standing longer than absolutely necessary, all requests for reprints should be made at time of submitting manuscript for publication. Rate card will be sent with galley proof.

Communications—Contributed articles, illustrations, letters, books for review, and all other matter pertaining to the editorial department should be addressed to the Editor, Doctor Martin Dewey, 25 East Washington Street, Chicago, Ill. All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 801-807 Metropolitan Building, St. Louis, Mo.

Illustrations—Such halftones and zinc etchings as in the judgment of the editor are necessary to illustrate articles will be furnished when photographs or drawings are supplied by the authors of said articles.

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Entered at the Post Office at St. Louis, Mo., as Second-Class Matter.

EDITORIALS

The Prevention of Dental Disease

DENTAL diseases, says the *Medical Record,* for some time have been fruitful subject for discussion. To an infected condition of the mouth and gums has been attributed a variety of diseases, more or less serious, and undoubtedly it is in this respect a factor of very considerable importance.

The causes of dental caries, according to Mr. J. G. Turner (*Journal of State Medicine,* London, September, 1918), have been shown by experiment to be two: (1) The presence of carbohydrates, starches and sugars; (2) The presence of germs. Carnivorous and grass-eating animals are free from caries. The Esquimaux used to be practically carnivorous, and it was found on examination of

skulls from an old Esquimaux graveyard that they did not suffer from caries. But today they have added fine flour and molasses to their dietary and are afflicted with caries.

It has been stated frequently by some authorities that masticating hard food acts as a preventive of tooth decay by giving the jaws exercise and that a great deal of the decay existing is due to the ingestion of soft pappy foods. However, Turner is inclined to throw some cold water on the theory and is of the opinion that big jaws and fine teeth are more a racial characteristic than a product of much use of the teeth. So far as diet is concerned, he points out that the eating of fruit decidedly cleans the teeth on account of its acid content.

With regard to the prevention of caries, Turner insists that the one essential is thorough cleaning, that is, every tooth which is exposed in the cavity of the mouth should be well rubbed once a day. The toothbrush must be supplemented by the use of waxed silk thread so as to scour each interstitial surface. At all schools a nurse's time would be well spent in teaching and supervising the cleaning of children's teeth, and such teaching should be begun at the earliest possible age. It is urged that if this plan were conscientiously carried out much of the dental caries which now exists so widely would be prevented and at the same time the sequelæ of prolonged dental disease would never occur. Turner lays down as the great principle of treatment that septic teeth are far more injurious than absence of teeth and that therefore the treatment of both caries and pyorrhea when well established should be carried on somewhat on the lines of forestry, removing some to isolate others. That artificial teeth are not a necessity is a statement with which many persons will find fault, although it is doubtless true that some of the mechanical dentistry which is undertaken nowadays does more harm than good. From the esthetic standpoint alone artificial teeth are more or less essential and the scientific dentist is as necessary for the proper conduct of the hygiene of the mouth as the all 'round hygienist and sanitarian is to the preservation and maintenance of the public health. The value of the dentist has been conclusively demonstrated by the war.

Care of the Teeth and Child-Welfare

THE Council of National Defense, although originally created for the purpose of fostering and promoting our war activities, has extended its sphere of influence and proved its value in such a manner as to merit being continued as a permanent institution.

Take, for instance, the Child-Conservation Section of the Field Division. Of course, the movement of promoting child conservation is an entirely proper one, on purely economic grounds, as an appropriate field for the activities of the Council of National Defense. It gains additional importance, since a serious and somewhat humiliatingly large proportion of the young men were found physically defective during the selective-service examinations.

The point of these remarks is, to refer to the recent suggestion, by the Child-Conservation Section, to the state chairmen of child-welfare, according to which

lessons on the care of the teeth are to be given by the teachers in the public schools. The examination of many thousands of school-children in this and other countries shows that nearly all have dental defects.

The results of these defects are innumerable, the most immediate being, a considerable impairment of the power to comminute the food. If there are too few teeth, or if they are broken, decayed or otherwise unfit for doing the work of chewing, or if they are so irregular that the grinding surfaces do not meet properly, mastication will not be complete, so that the other digestive organs will have to do the work neglected by the teeth.

Digestive disturbances inevitably follow. Many forms of illness result from the presence, among the roots of decaying teeth, of tiny pus-pockets, which continually discharge their poisonous contents into the blood stream. Furthermore, there is abundant evidence to show that the bacteria of disease, including those of tuberculosis and diphtheria, find lodgment in dental cavities and in irregularities of the teeth. The neglect of proper cleanliness increases the possibility of attack by many kinds of disease.

While all this is rather elementary, it may serve to suggest to dentists and physicians just those terms and words that they might employ in teaching their patients to practice suitable care for the preservation of not only their own teeth, but even more especially, of those of their children.

Permanent Staff Appointments of Forsyth Dental Infirmary

A COMPETITIVE examination of graduates in dentistry (of less than three years' standing) for appointments to positions on the Permanent Staff for full and one-half time service will be held early in June at the Forsyth Dental Infirmary.

Appointments will be made for one or two years as follows: Full time service requiring operating five and one-half days a week at a salary of $1000 a year; One-half time service requiring operating six half-days a week, either forenoon or afternoon, at a salary of $500 a year.

These appointments will be made subject to satisfying the requirements of the Massachusetts State Board of Registration in Dentistry and to "qualifying" in the practical work of the clinics during one month's trial.

Members of this staff are entitled to the advantages of reports and clinics by experts in the various branches of Dentistry from different parts of the world in addition to the numerous special and regular clinics and lectures. Operators after serving four months are eligible, by qualifying, for appointments in the special clinics where Post Graduate work is given. The operators on this staff have the advantage of the clinics and lectures of the Post Graduate School of Orthodontia. The Infirmary clinics provide unusual advantages in the various departments of the institution where Operative Dentistry, Orthodontia, Nose and Throat and Oral Surgery, Extracting, Novocaine Technic, Radiography, Pathological Diagnosis and Research work are continually carried on.

The average number of cases treated daily in the various clinics is over 300. Supplies and necessary operating instruments are furnished; up-to-date apparatus including electrical engines, sterile instrument trays, fountain cuspidors, compressed air, and the modern operating-room-type of laboratories are available for use. A diploma of service will be issued by the Trustees to each member of this staff who has completed this term of service in a satisfactory manner. Applications for the above positions should be made not later than May 15th. Information and the date of the examination will be furnished to those interested by Harold DeW. Cross, D.M.D., Director, 140 The Fenway, Boston, Mass.

Preparedness League Notes

EARLY last autumn the President of the League wrote to different members of the Dental Corps in France, seeking information as to the condition of the dental profession in the devastated regions, but has been unable to get definite data except from Captain Blake Sears, who has, during his available time, been making a survey of those conditions which call for aid from the dental profession of America and Canada.

In a partial report Captain Sears states that there is a great need for help, and strongly approves of action in this direction. The matter was brought to the attention of Dr. Villian, who heartily endorses the movement and is anxious to collaborate with us. He was one of the organizers of a society in Paris to carry on this work. Funds were raised which already have been exhausted, and the time is opportune for us to show our fraternal spirit by raising funds and supplying equipment for this society to place where it is most needed. Before this notice will be printed, we hope the movement will be well under way and some funds made available for this purpose.

We are getting reports from different parts of the country of the excellent service our members are giving the worthy families of the Soldiers and Sailors. This is a most commendable object, and we sincerely trust that it will be continued so long as there is actual need. It is a splendid and practical way of demonstrating our readiness to help compensate for the sacrifices made by our boys.—J. W. BEACH, *President.*

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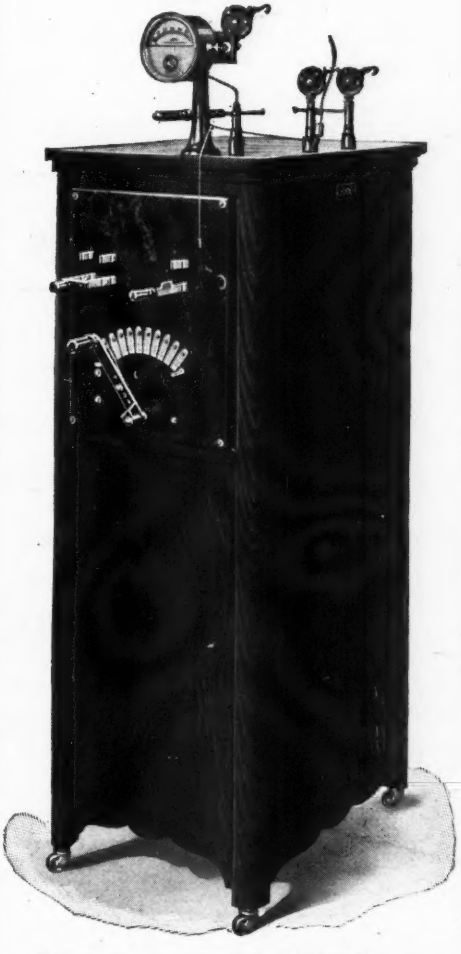

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